

POPULAR SCIENCE

MONTHLY OCTOBER 25¢



MYSTERIES OF VOLCANOES
are solved for science by Mexico's
19-months-old Parícutín. Page 118.



GLOBAL AIR FORCE
B-29 airmen wear this shoulder patch.
Other air-force insignia on page 121.

***JAPAN DOOMED TO QUICK DEFEAT
BY OUR DARING PACIFIC CAMPAIGN***

**SEE
PG.
67**



OPTICAL WONDERLAND
of the kaleidoscope in full color.
Learn how to build one on page 110.

WHAT'S SHE SAYING?
Can you read the flag language of
the sea? Code flags in color, page 102.





Strato-Flak *by Fisher*

The Army-Navy "E" flies above four Fisher Body plants for excellence in aircraft production and from two others for tank production, while the Navy "E," with four stars, is flown by still another Fisher Body plant for its naval ordnance work.

NO one had ever seen a gun like this three years ago.

But when bombers took to the stratosphere, Army Ordnance engineers realized the need for a 120-millimeter gun, deadly to both air and ground targets at long ranges, and capable of a high rate of fire. So they worked it out with Fisher Body.

Practically every tool, jig and machine used in production was especially designed for it. But our special pride was the automatic loader and rammer—a Fisher contribution which can set the timer before the shell is shoved home. A lot of midnight oil was burned before these black mushrooms began to burst at 60,000 feet.

Once more, we were grateful for the Fisher skills and techniques that saw us through. The

same Fisher Body craftsmanship that has turned out tanks, guns, bomber assemblies and other armament concentrated on this new puzzler—and came up with the right answers.

Our fighting men rate the best fighting tools in the world. We intend, now as always, to help give them whatever they need, and the best we know how to build.

Every Sunday Afternoon
GENERAL MOTORS SYMPHONY OF THE AIR
NBC Network



armament
BOX BY

Fisher

D I V I S I O N O F G E N E R A L M O T O R S



The tire that lights an electric bulb

An illuminating development in rubber that took the "shocks" out of flying

AN AIRPLANE in flight builds up a strong charge of static electricity, which once meant danger of sparks and fire—also danger of shock to passengers and crew.

The electricity would have passed harmlessly into the ground as soon as the plane's tires touched the earth if the rubber could conduct electricity. But rubber was an insulator; it *prevented* the electricity from leaving the plane. Could it be made into a conductor?

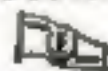
B. F. Goodrich engineers believed it could. They had already helped develop special carbon blacks to resist heat. Experiments were made with new ones to conduct electric-

ity. After many attempts, tires were built that can be placed in an electrical circuit and conduct the current into an electric bulb, as in the laboratory test shown above. And today, hundreds of airliners come to earth more safely on the new conductive tires.

B. F. Goodrich improvements in tires apply to every type of tire America uses—tires for planes, passenger cars, trucks, farm machinery. For passenger cars B. F. Goodrich made and sold tires containing synthetic rubber back in 1940, the first ever sold to American car owners and the only ones sold before the war. Their use by thousands

of people made up a road test estimated at over 80 million miles. Some of the tires are still running today, many without even being recapped.

If you can buy tires today, and if you buy B. F. Goodrich, you get tires backed by three years' extra experience; by that 80,000,000-mile road test; backed also by dozens of developments and improvements in rubber and synthetic-rubber compounds. The B. F. Goodrich Co., Akron, Ohio.



In war or peace
B.F. Goodrich
FIRST IN RUBBER

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- 1 "CIRCUS CAPERS"**
Puddy sneaks under tent. Sees Fifi with Apache dancer. Thinks her abused! Socks partner! What zany fun!



- 2 "DOWN IN THE DEEP"**
Puddy's pal encounters sea monsters. Puddy pumps! Inflates diving suit. Pop!... Puddy's pal comes to surface... saved!



- 3 "DOG WANTED"**
Mary adopts Puddy who likes his Beas better than a bath. It is furious fun when Puddy's Beas return home!



- 4 "PUDDY PICKS A BONE"**
Puddy falls into a barrel and is almost caught by the chef, but grabs some chickens and escapes. All ends happily.

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SPECIAL TUITION RATES FOR MEMBERS OF THE ARMED FORCES

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Kodachrome

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BAILEY BRIDGE. Enemy demolitions can't stop Allied troops equipped with this grown-up Erector set, whose interchangeable parts can be joined quickly to make a bridge of any type needed. Built on one side of the road gap, the span is pushed across as it grows. Story and pictures on page 94.

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WARTIME OPPORTUNITIES for You in ACCOUNTING



Accounting faces an unusual situation during this war period. The need and demand for accountants—both beginners and experts—is increasing while the

supply is diminishing. That spells opportunity for many—perhaps for you.

The reason is simple.

Government needs more accountants. Many new activities are enlarging old bureaus and creating new ones—military, supplies, taxes, priorities, social security, price regulation, more indeed than we can name here.

Industry needs more accountants. New plants, enlarged plants, conversion to war production, more government regulations and reports, taxes, priorities, etc.—all call for more and better records.

This need will persist and increase all during the war—it will open many, many fine jobs, fine both in responsibility and pay. Nor will it end sharply with peace—it will continue through the difficult post-war adjustment period.

Yet many present accountants are going into the armed services. Their places and the calls for more accountants can only be filled by new men and women coming into accounting and coming quickly.

Can You Grasp This Opportunity?

That depends largely on you.

The opportunity is open most directly to women and to men not called to service (although we know of our accounting students given specialized duty and ranking in the army and navy).

If you are ambitious, willing to work hard in preparation and are at least average in mentality and education,

this opportunity to serve a national need and profit personally is open to you. It will take real work but the rewards will be correspondingly good.

We Can Help You

Through our interesting, practical training—developed in 36 years of training accountants—you can learn accounting from the ground up or from any point where you now are in accounting. You need not lose an hour from your present work. The cost will be moderate and the payment terms easy. Free placement aid. And soon—surprisingly soon—you will be ready for the simpler positions and on your way up.

Your first step is to investigate. Ask for our free 48-page booklet, "Accountancy, the Profession That Pays." It tells of the opportunities and requirements in accounting and describes how you can prepare for them. It can be your starting point towards real success and income. Send the coupon—today.

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TELEPHONE lines are lifelines wherever our men fight. The lines lengthen with every mile of advance.

Bell System manufacturing facilities have had to be devoted almost exclusively to keeping the armed forces supplied with communication and electronic equipment. As a result, we are

short of telephones, switchboards and other equipment needed to meet civilian requirements.

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• Please give the service men and women first chance at Long Distance between 7 and 10 each night.

Coming Next Month

THE BATTLE AGAINST RUST is being won by new oil compounds that will save billions of dollars a year. Atomic exploration has resulted in oils that get underneath water or other moisture and protect metals from even the slight corrosion that will throw precision instruments off balance. Rustproofing as it is done today is the biggest anti-saboteur job that is being carried on.

PITCHING FOR DEAR LIFE, the Yank soldier throws 54 cents' worth of cast metal and explosive. On the receiving end it's mighty discouraging to Jap fighters, for the hand grenade spreads 40-odd metal fragments over a 90-foot radius when it goes off. This story is packed full of information about the hand-tossed bombs that GI's use with such deadly effect.

SMALL BOATS ARE LIKE BEARS. They hibernate in winter. The process of getting the boat shipshape for snuggling down during the off season in northern waters is made clear in this article by an experienced yachtsman. It tells how to make a winter cover, and solves such problems as moorings, ice protection, and shoring.

MONEY SURE IS FASCINATING. Here's an article that presents an angle of the subject about which little is generally known—the identification of mutilated bills by skilled women in the U. S. Treasury Department's Currency Redemption Division. Really "filthy lucre" as well as charred and otherwise damaged currency passes through this department, and it's nothing short of marvelous how these women identify the remains.

LESS FUEL, MORE HEAT, NO BOTHER. Working in collaboration with the coal industry, home-heating experts have developed postwar furnaces that promise more comfort at lower cost as well as automatic operation. In the next issue you may have a preview of the new "vest-pocket" furnaces that are based on new and revolutionary principles. Here is good news for the householder.

DIZZY SPEEDS, DEVASTATING BLASTS make American low-altitude bombing a menace to our enemies. Read the how and why of our terrific flying catapults and learn the technique of the pilots who man them. Here is inside stuff about a job that is as effective as it is picturesque and dangerous.



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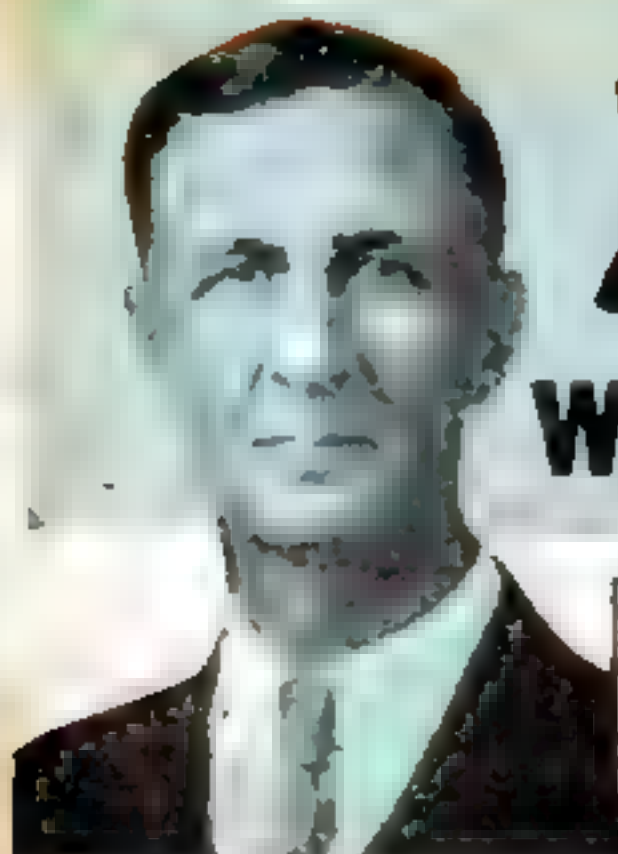
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istration as a radio
operator. After a few
months of training
and a few months of
experience, he was
promoted to Chief
Operator. **JOHN E. SMITH, Box
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**\$200 a Month
in Own Business**
For over a year
I have been in busi-
ness. The money I
make is more than
a month's salary. I
have a steady in-
crease. I have
N.R.I. to thank
for my start in
this. **ARL J. HUBB,
1511 3rd West Texas Avenue,
Quincy, Texas.**



**\$5 to \$10 a Week
in Spare Time**
I am engaged in
spare time radio
work. I average
from \$5 to \$10 a
week. I often
wonder that I had
not started sooner
because all this
extra money sur-
rounds a hobby. **THEODORE
K. DUBRE, Harrisburg, Pa.**



**Chief Operator
Broadcasting
Station**
"Before I com-
pleted your lec-
tures, I obtained
my Radio Broad-
cast Operator's
license and im-
mediately joined
station WJPH where
I am now Chief Operator." **HOLLIS F. HAYES, 37 Medi-
cal St., Loper, Michigan.**



**Salary Increased
\$1,400 Year in
Radio**
"I have been re-
siding in a garage when
I started with
N.R.I. I am now
Chief Operator of
WJPH. My salary
has increased
\$1,400 per year." **JULIAN C.
VINCENT, Station WJPH,
Chattanooga, Tenn.**



**Radio Service
Manager
of 4 stores**
"I was working
in a garage when
I started with
N.R.I. I am now
Radio Service
Manager for 4
Furniture Co. for
their 4 stores." **JAMES F. RYAN, 115 Public
Court, Paul River, Mass.**

I Train BEGINNERS at Home for Good Spare Time and Full Time Radio Jobs

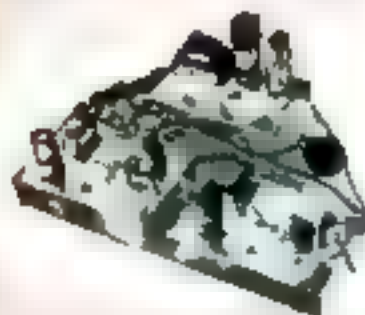
Here's your opportunity to get a good job in a busy field with a bright peacetime future! Today there is a shortage of trained Radio Technicians and Operators. So mail the Coupon for a FREE copy of my 64-page, illustrated book, "Win Rich Rewards in Radio." It describes many fascinating types of Radio jobs; tells how N.R.I. trains you at home in spare time—how you get practical experience building and testing Radio Circuits with SIX BIG KITS OF RADIO PARTS I send!

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Broadcasting Stations, Aviation Radio, Police Radio, Loudspeaker Systems, Radio Manufacturing all offer good jobs now to qualified Radio men—and most of these fields have a big backlog of business that is building up during the war, plus opportunities to expand into new fields opened by wartime developments. You may never again see a time when it will be so easy to get a start in Radio!

You Build These and Other Radio Circuits with 6 Big Kits I Send!



**SUPERHETERODYNE CIR-
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oscillator-mixer-first detect-
or i.f. stage, diode detector-
a.v.c. stage, audio stage.
Bring in local and distant
stations on this circuit you
build yourself!

**MEASURING INSTRU-
MENT (below)** You build
early in course. Use it in
Practical Radio work to
make EXTRA money. Vac-
uum tube millimeter, meas-
ures A.C., D.C. and R.F.
volts, D.C. currents, resis-
tance, receiver output.



**A.M. SIGNAL-GEN-
ERATOR (above)** Build
it yourself! Provides
amplitude-modulated
signals for test and
experimental purposes.
Gives valuable practice!

By the time you've
conducted 60 sets of
Experiments with Ra-
dio Parts I supply,
have made hundreds
of measurements and
adjustments, you'll
have valuable PRAC-
TICAL Radio experi-
ence for a good full or
part time Radio job!

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with a Bright Future

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a week EXTRA in Spare Time**

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MAKE MORE
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OCTOBER, 1944

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11



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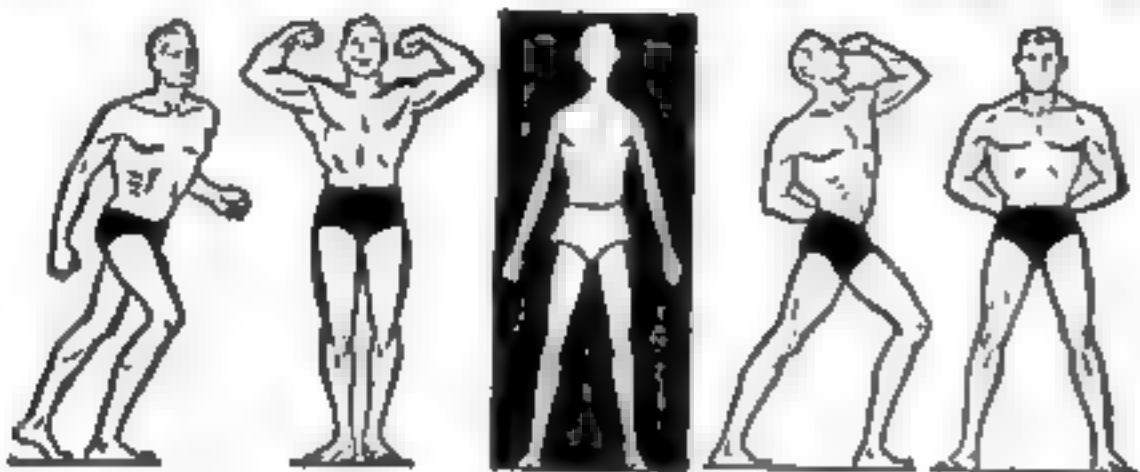
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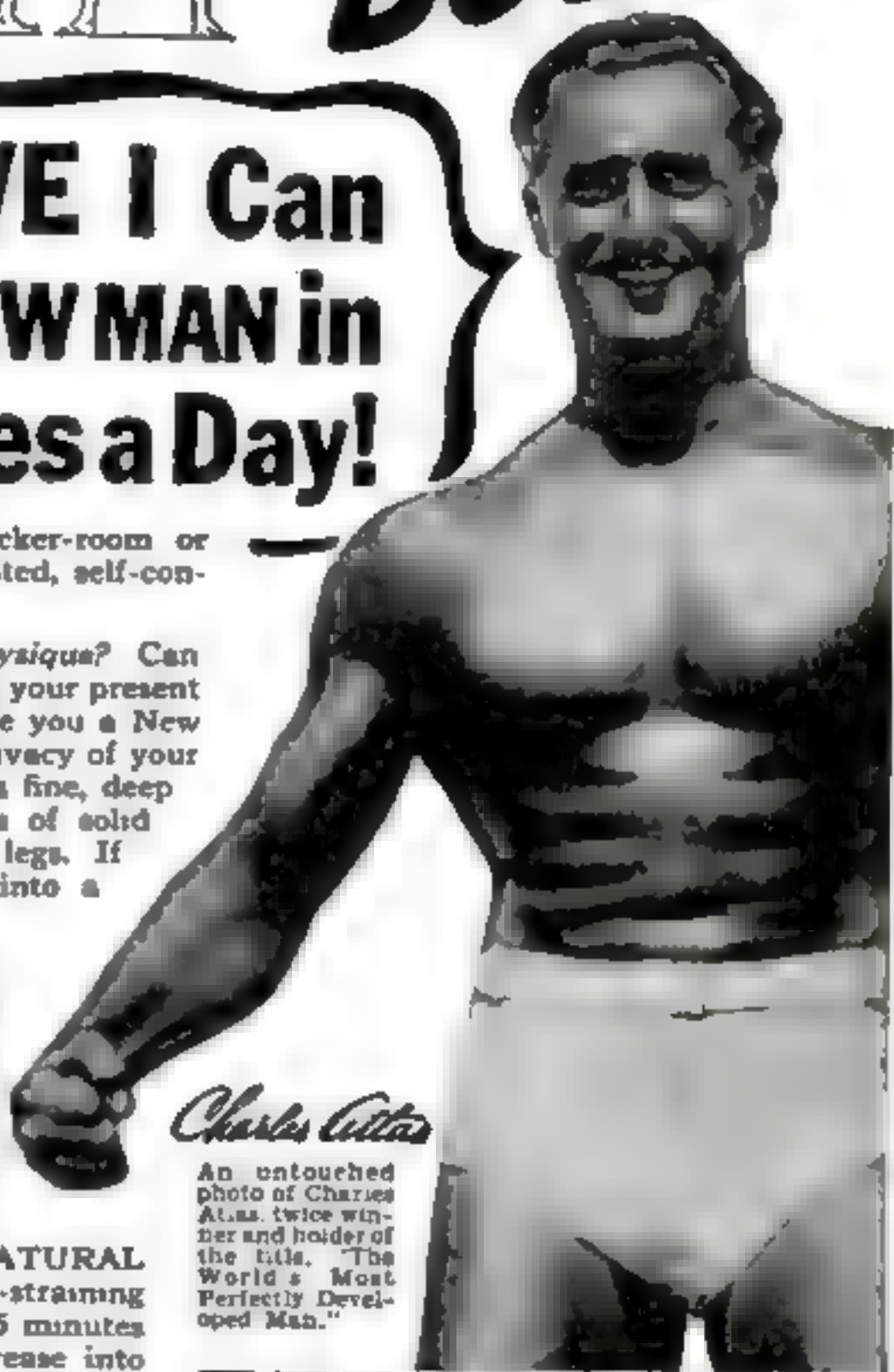
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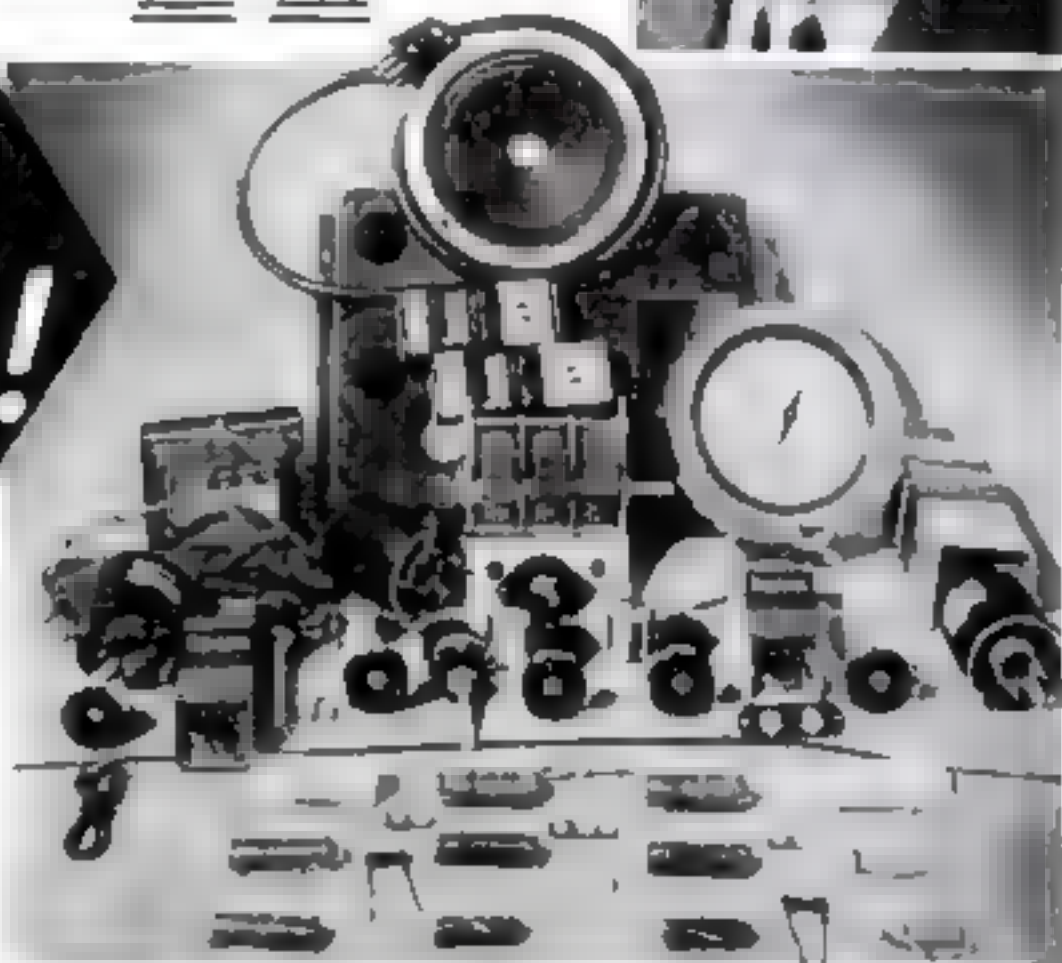
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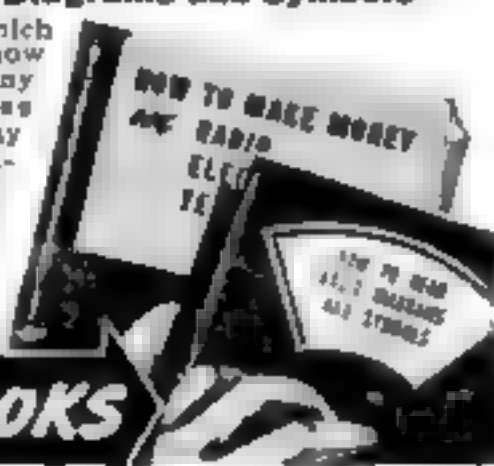
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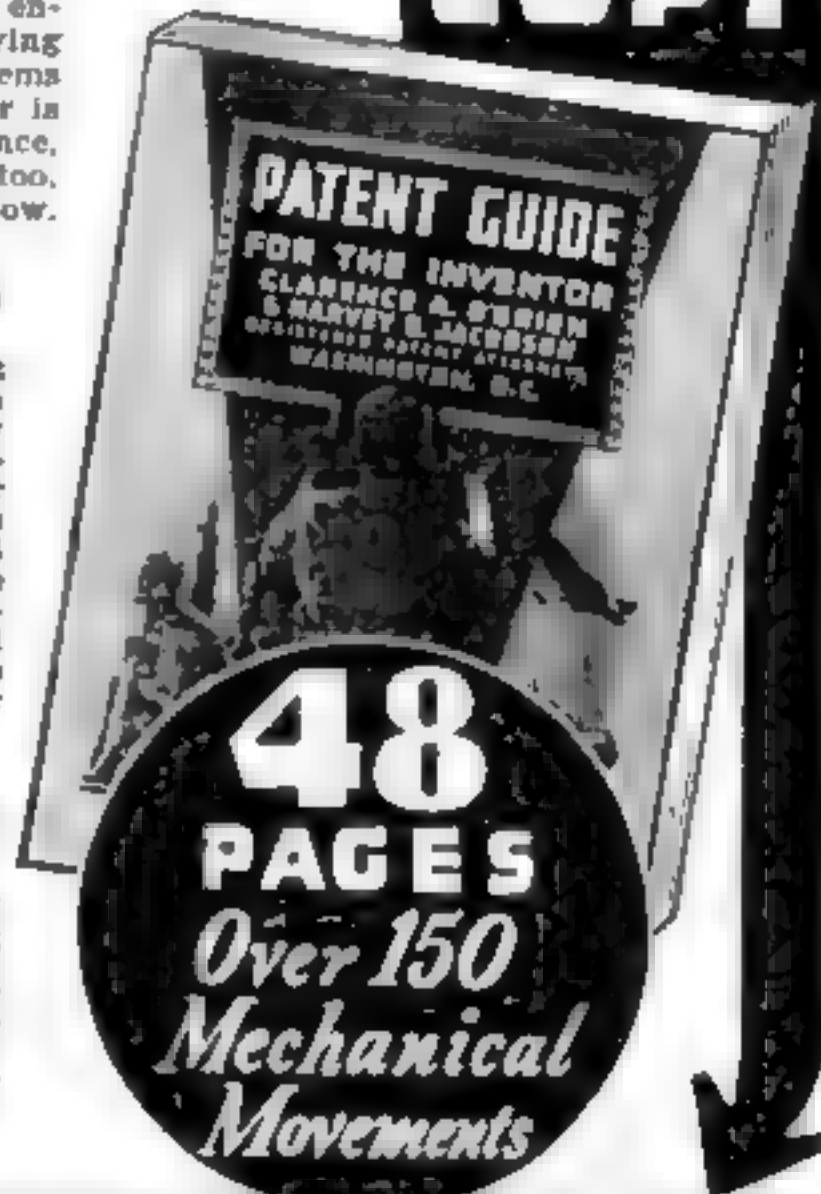
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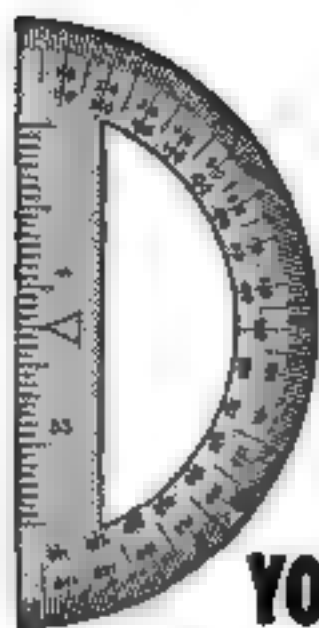
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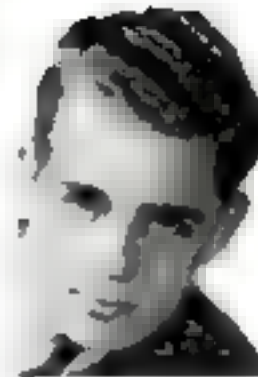
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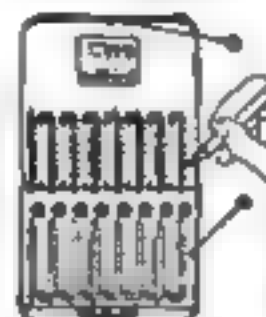
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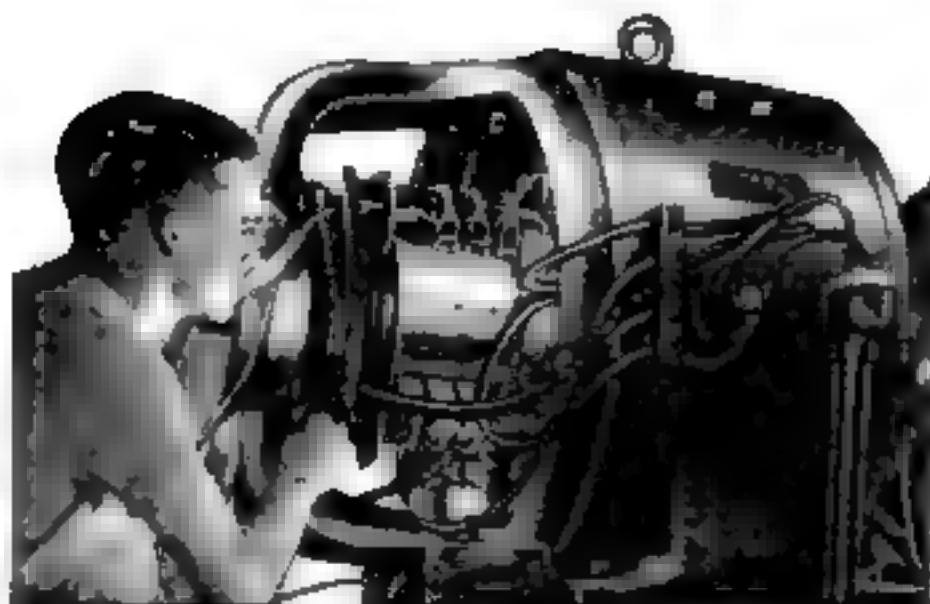
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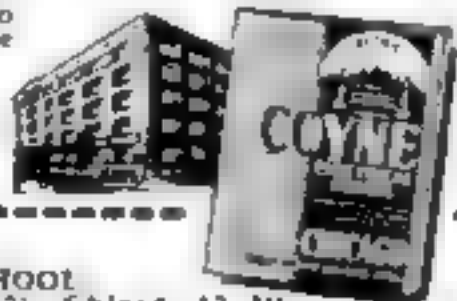
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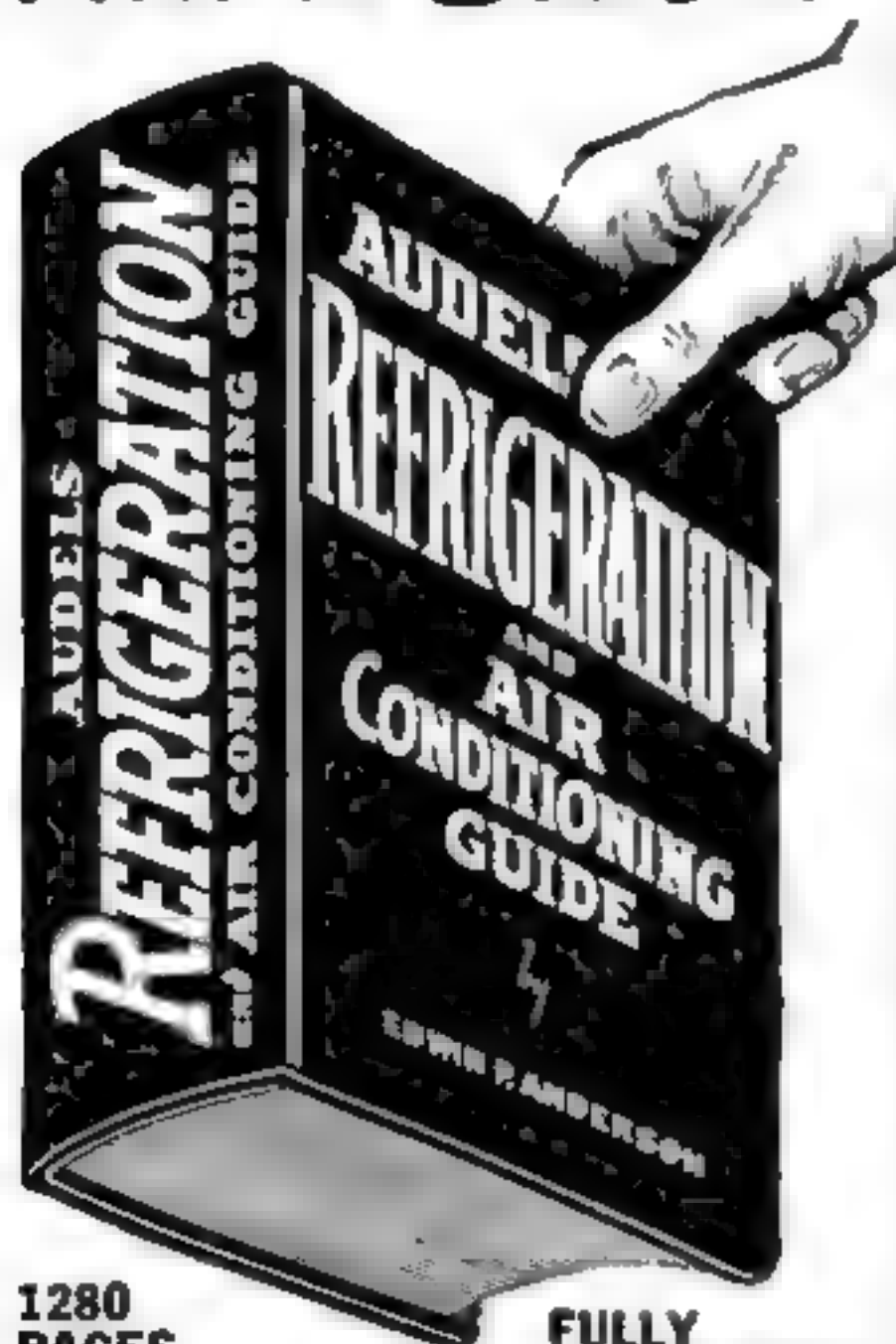
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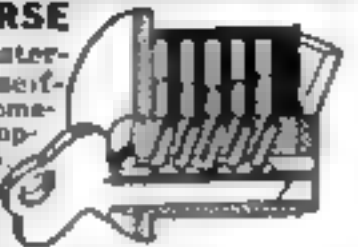
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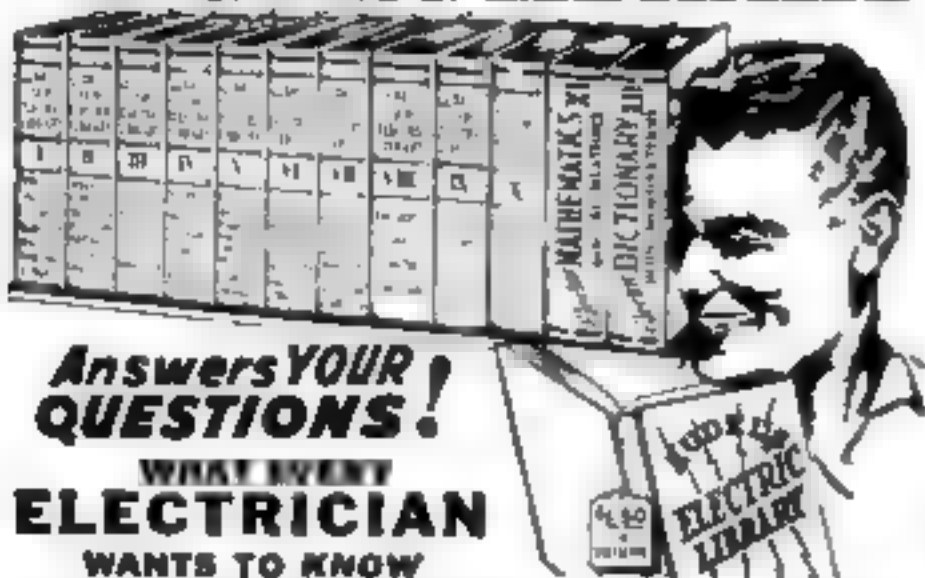
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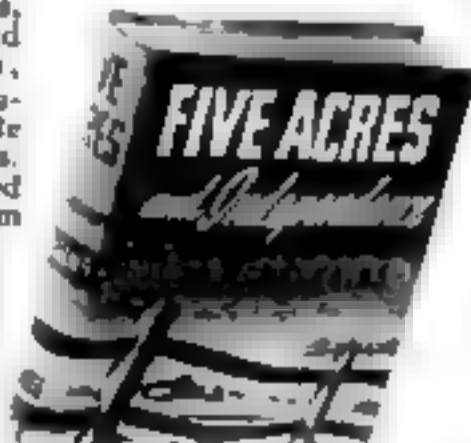
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Now somebody comes along and tells me that diamonds are used in the manufacture of airplanes. Whether it's true or not, I am glad to believe that diamonds are coming to have some useful purpose other than as baubles to decorate a dowager's neckline. What I want to know is: how are diamonds used for airplanes? Are they placed in the motors as delicate bearings, or are they used in the tools with which the planes are made? —M. K. F., Seattle, Wash.

These diamonds are used principally for testing metals and for resurfacing grinding wheels employed in the making of airplanes. Testing machines use both perfect jewelers' diamonds and industrial diamonds, but for resurfacing grinding wheels the stones are all of the industrial grade. They range in size between 1/20 carat and six carats.—Ed.

Splitting the Infinitesimal into Even Smaller Parts

THE article "Magic With Magnetism" in P. S. M. started me thinking. So far, all we have ever used magnetism for is its power of attraction and repulsion. In other words, it is in about the same state of development as electricity before Volta experimented with his pile and obtained continuous current. Before that, most electrical experiments centered about the attraction and repulsion of static

Readers Say:

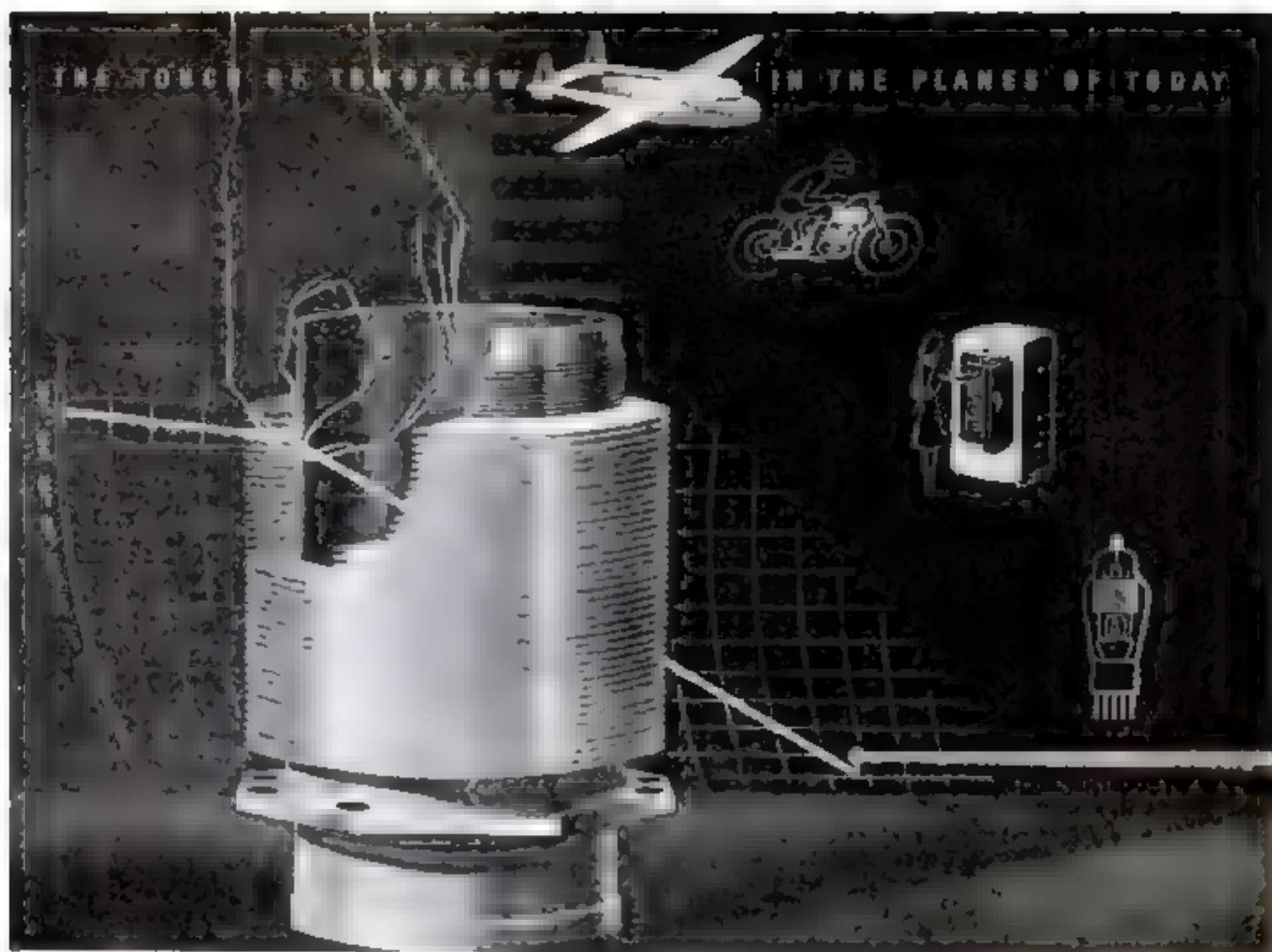
charges. Nobody connected magnetism and electricity because a static charge has no magnetic field. Similarly, a static magnetic charge such as we have always used has no electric field. We had to introduce relative motion before we were able to produce an electric current by means of magnetism.

Now to go a step further. The electron theory supposes three elemental parts of an atom. Why not four? Proton and electron for positive and negative electric charge, and neutron for north and the counterpart of the electron for the south-pole charge. In fact, the magnetic electron has already been suspected and has been named the "neutrino." In this connection it is interesting to note that uranium 235 contains a large excess of neutrons and that it was separated from uranium 234 and 238 by magnetic means; also that the means of obtaining power from uranium 235 was by decomposing water somewhat as Professor Ehrenhaft did. It might be that the men working on 235 and the Professor were on the same track without realizing it.—R. P., Hanna, Alberta, Canada.

P. S. M. Paper Drive Idea Meets With His Approval

Your timely suggestion in the September P. S. M., that we readers contribute our old copies of the magazine to the nation-wide salvaging of waste paper, should meet with 100 percent approval from every loyal American. Don't think I fail to realize what this means. I have been a subscriber to P. S. M. for 10 consecutive years, and I have kept every single number. I have protected this valuable collection against many insinuations that it was taking up too much room. I developed a sort of woodman-spare-that-tree attitude. So it came hard to bundle up 120 copies of the magazine and turn them in. There was 90 pounds of paper in all. Later I read that 10 pounds of scrap paper will make 20 blood-plasma containers. So I figure that I have given the raw material for 180 containers, and it makes me feel pretty good.—B. D. C., New Haven, Conn.





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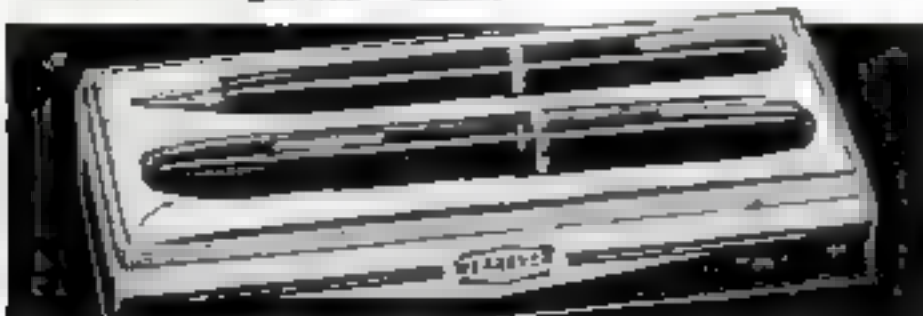
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Readers Say:

At Last—a Possible Use for the Squeal of a Pig

WHEN peace comes, the scientists who have been doing such wonderful war work should be kept busy, under a Government subsidy if needful. Here is a suggestion. The principle of the sound-powered telephone described in the August P.S.M. could be extended so that enough electrical power could be generated to compensate for the gasoline shortage. But first a suitable transformer should be developed to step up the currents produced. After that, the installation of the apparatus and an electric motor in automobiles would not only conserve gas but make the back-seat driver an actual asset instead of a liability. Power companies would bid for the privilege of installing sound-power microphones at every afternoon bridge party in the land, but in this case great care would have to be taken to guard against blown-out fuses. Political conventions and baseball games would also provide much power, to say nothing of juke boxes and similar sources of bedlam.—S. P. T., Walla Walla, Wash.



Two Experiments—One of Them Photographic, & Other Insomniacous

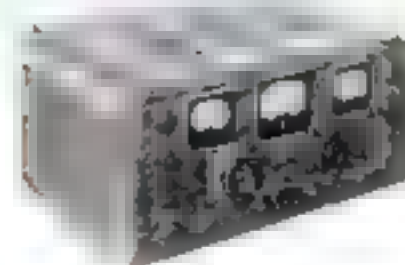
Those who are photographically inclined might like to try the experiment of making direct positives on ordinary film simply by overexposing it in the camera. Use an exposure of 10 minutes or so in daylight good enough for a 1/25-second snapshot. I once got a roll of pretty good pictures that way on film that had been through an out-of-focus Brownie. I simply coiled the film back on the original spool, and ran it through the camera again, using the long exposures. When you get sleepy sometime, see if it will help you to keep awake to rehearse mentally the motions of typewriting something over and over again at top speed.—E. N., Prescott, Wisc.

Negative results, artistically speaking, are usually the effect of trying to make direct positives E.N.'s way, but where would photography be if folks weren't willing to try things? We tried the remedy for sleepiness, but our top speed with the typewriter isn't too good, so it didn't work.—Ed.



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"Young man — you have it!" said the Wizard of Menlo Park

IT IS A warm August evening in 1896. Around a banquet table on Long Island sit Thomas A. Edison and the country's leading men of the electrical industry.

The talk swings naturally to politics, to Bryan and McKinley and the Cuban situation—then back again to business. There is high discussion about storage batteries to drive America's "horseless carriages". Someone points to young Henry Ford, Chief Engineer of the Detroit Edison Company, and says: "There's a man who has built a gas car!"

At once, Edison eagerly begins to ask questions—and to listen. "How do you explode the gas in

the cylinder? Do you do it by contact or a spark?"

On the back of a menu, Henry Ford sketches the details of his engine. Edison thumps the table so hard the glassware tinkles.

"Young man, that's the thing—you have it. Keep at it. Your car is self-contained—carries its own power plant—no fire, no boiler, no smoke, and no steam. *Keep at it!*"

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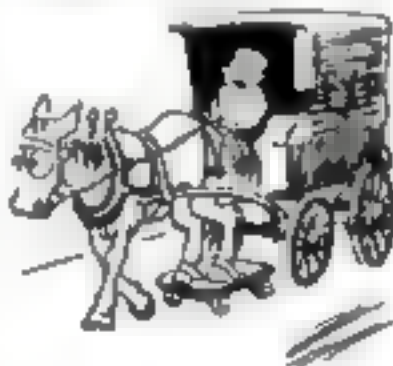


Readers Say:

You Can't Expect Leverage Unless You Have Fulcrumage

IN your August issue, S. van D. P. wants to know which was first created, the lever or the fulcrum. I'll say it's immaterial; one is dependent on the other. Remove one of them and you have nothing. If your correspondent doesn't believe it, ask him to produce a hen without an egg. Here's another one: A horse has four feet; he pulls with the two front ones and pushes with the two back ones. Harness the horse to a wagon, and prove to me that the horse pulls it.—W. J. D., Woonsocket, R. I.

THIS HORSE
PULLS THE
WAGON—



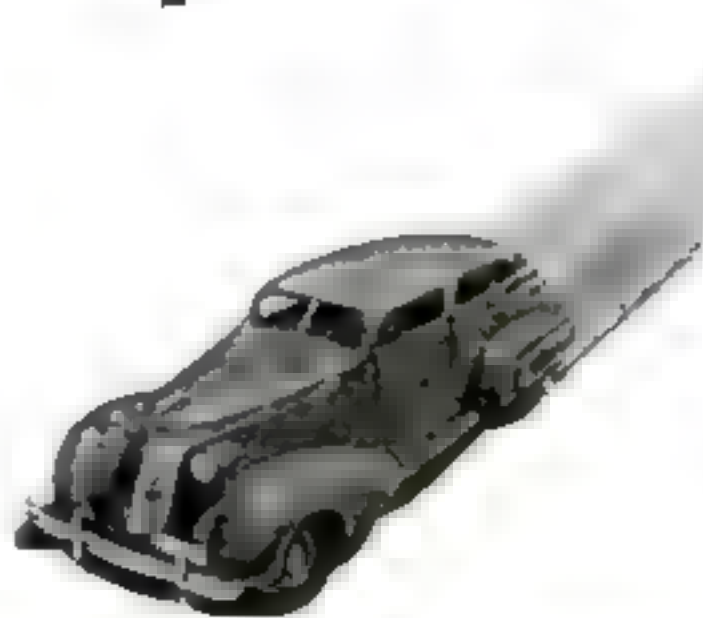
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C. B. COLBY, Aviation Editor, says: "I think you have in mind the true velocity of the bullet and not the muzzle velocity as mentioned in your letter. Muzzle velocity is the relative velocity at which the bullet leaves the muzzle of the gun, no matter whether the gun is in motion or not, and is entirely dependent on the powder charge behind it. Velocity of a projectile (without "muzzle" before it) is influenced by the motion of the gun from which the bullet emerges, and the speed of the armament should be added or subtracted from the muzzle velocity when talking of the true velocity of the projectile in relation to a point on the ground. Muzzle velocity never varies with gun motion; true velocity does."—Ed.

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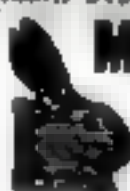
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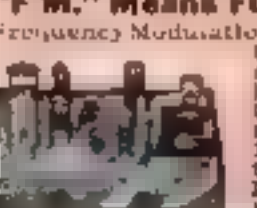
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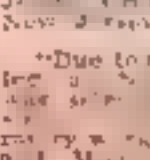
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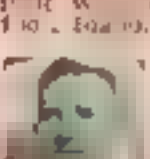
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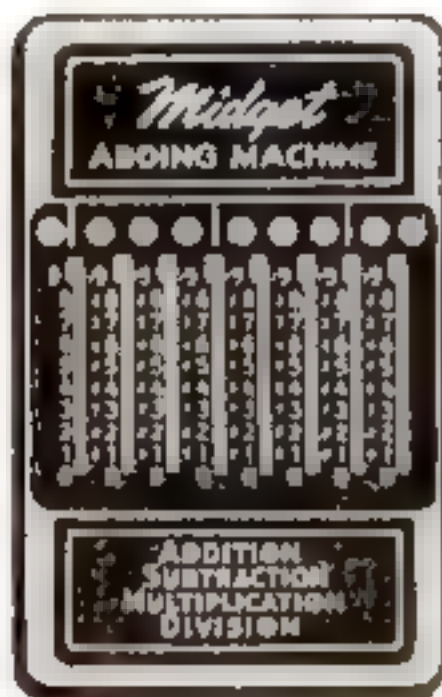
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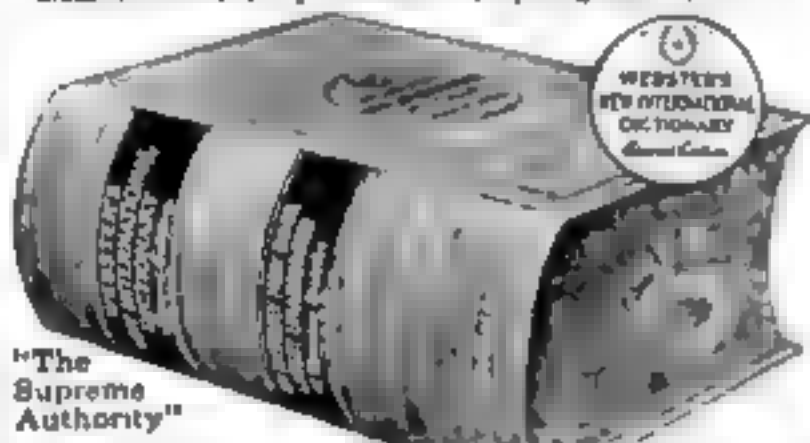
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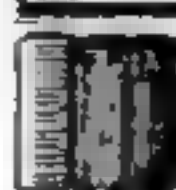
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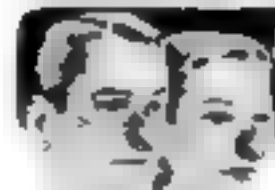
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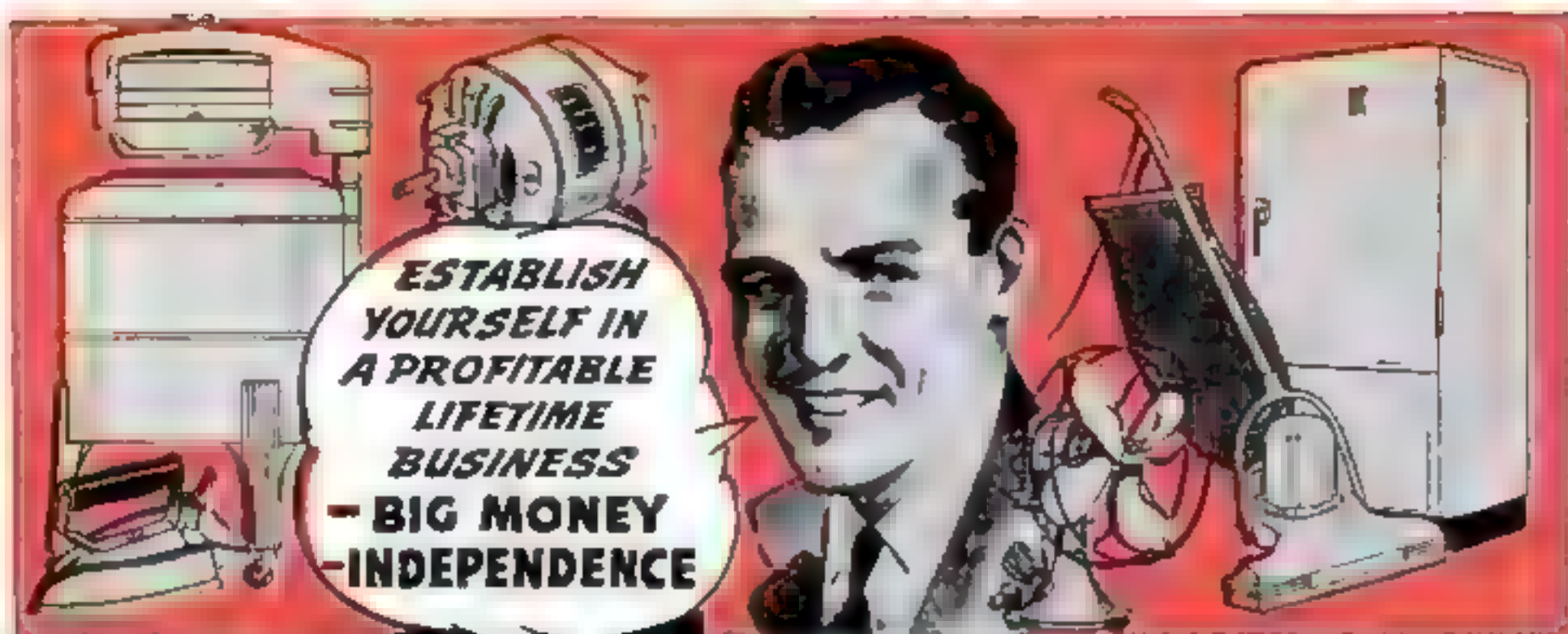
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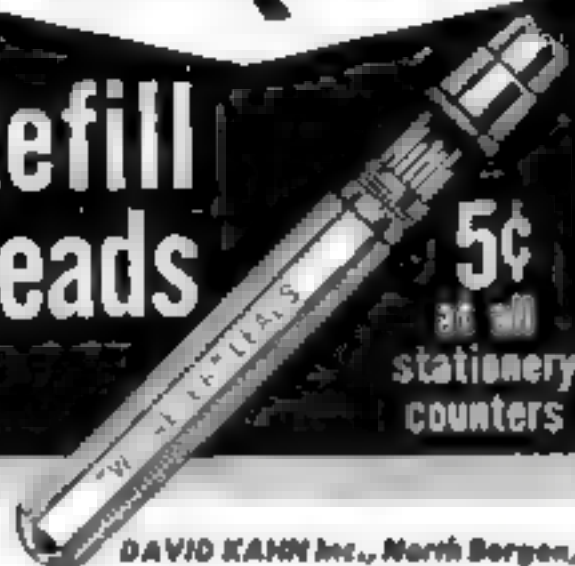
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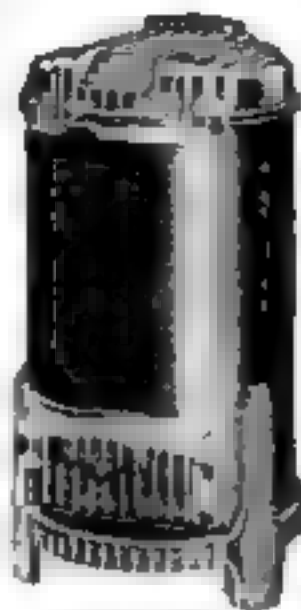
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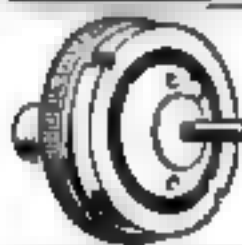
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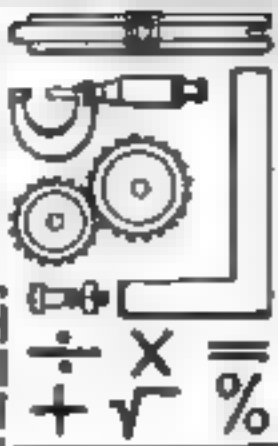
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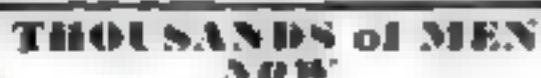
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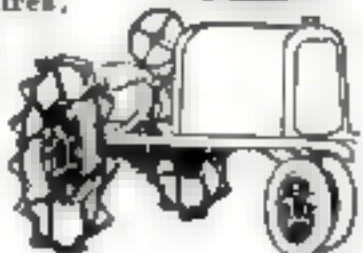
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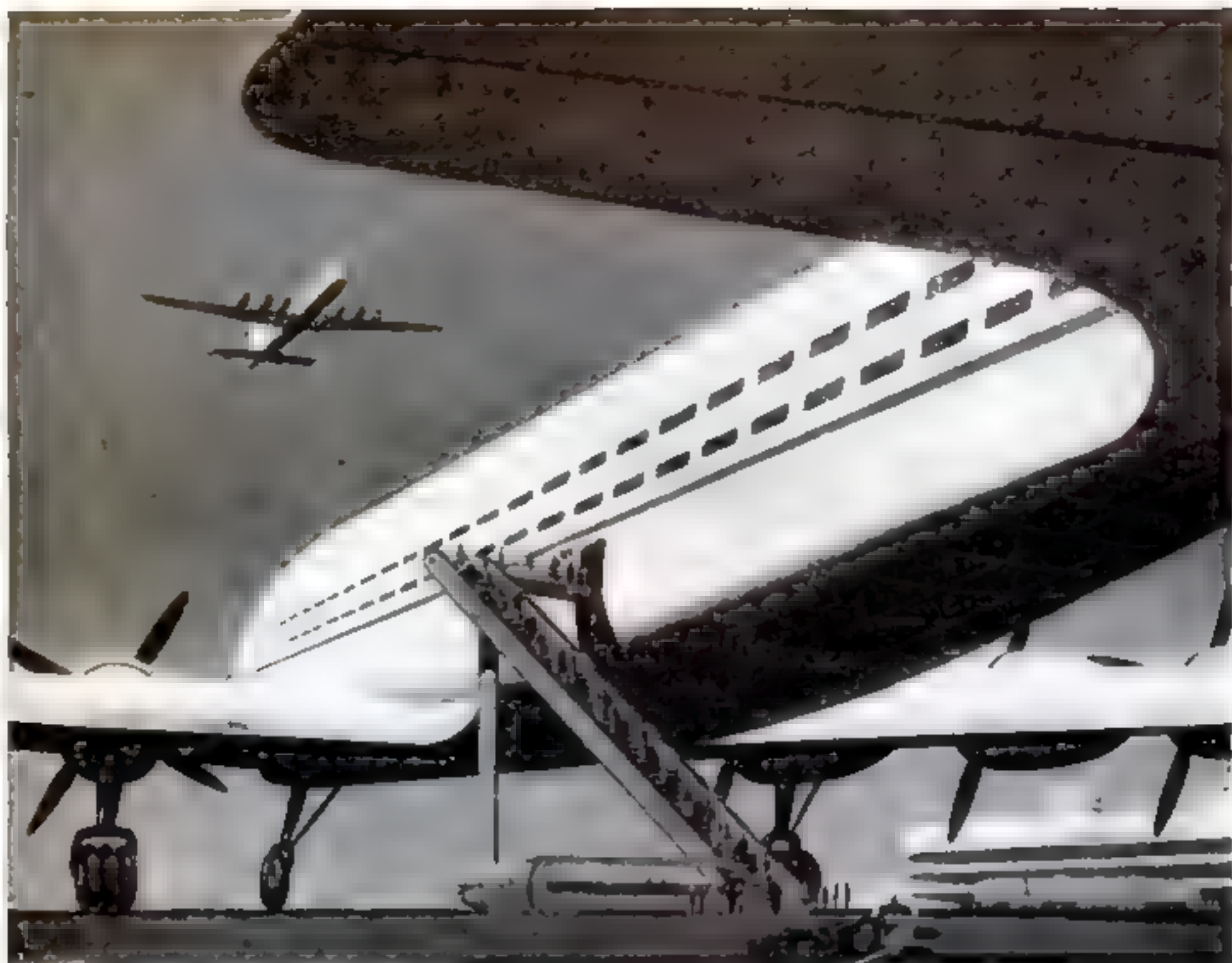


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PATTERN FOR PACIFIC VICTORY



HERE, in miniature, is the technique that is beating the Japs. In August 1942, the Allies faced a colossal job—rooting tens of thousands of enemy troops out of the jungle-matted Solomons. The Japs had, or were building, strong fortifications, buttressed by airfields, on Bougainville, Kolombangara, New Georgia, Santa Isabel, and Guadalcanal. Jap security details infested most of the other islands, including Malaita. The Allies first seized Guadalcanal and its airfield, and Tulagi Harbor on Florida Island. Occupation of Florida plugged, in time, the lower end of "The Slot," the route of the sea supply train known as the Tokyo Express. Then, ignoring the eastern Solomons chain, they moved to the Russell Islands and New Georgia. Part of a Jap patrol on Malaita was killed; the rest were left to the island's headhunters. When the Japs abandoned their naval concentration point of Rekata Bay and all of Santa Isabel, it was evidence that they could not hold islands within the range of Allied bombers protected by a fighter cover. The Slot was closed to Jap operations on New Georgia in August 1943. Allied airplanes based on New Georgia made Kolombangara useless to the Japs. Our subsequent investment of Vella Lavella forced the Japs to evacuate their Kolombangara troops. Next we moved into Mono and Stirling islands in the tiny Treasury group. When we stormed into Empress Augusta Bay on Bougainville, we began isolating the Jap air staging point at Kahili and the naval concentration area of Bulu-faisi. That move, too, brought the great Jap bastion of Rabaul (see map, page 69), backstop for the Solomons, within easy torpedo and dive-bomber range.

Revealing the strategy that has carried us in 29 months from the gates of Australia to the front door of Japan.

By DEVON FRANCIS

IN THE far reaches of the Pacific, the United Nations have pinched off and left to die between 150,000 and 200,000 crack Japanese troops.

In the coming months, other scores of thousands of Jap soldiers will be isolated and—because they seldom surrender—will be left to die from a lack of supplies. Occasionally they get killed when our airmen use them for bombing practice.

These Japs were "contained," as the military phrase has it, in island pockets on the bosom of millions of square miles of ocean by "leapfrogging" over them. They simply were by-passed and then neutralized at our leisure by air and submarine action.

The technique has saved, and will save, the lives of countless Allied soldiers. It saved matériel. Just as important, it saved valu-

able time. Leapfrogging may mean that the seat of Japanese empire itself, where for a half century men schemed a conquest of the world, will tumble without an Allied infantryman exposing himself there to enemy rifle fire. It is speeding the end of the war. To have retaken each of the Jap-occupied islands between Tokyo and the perimeter of our original defense line would have required many years of effort.

Our adoption of the leapfrog technique grew out of one of history's boldest military gambles—the decision in mid-1942 to defend Australia. Relatively speaking, we had little more than cap pistols to do it with.

But the success of the venture explains in good part the rapid collapse of Japanese naval strength in the western Pacific in the last seven months.

Back in 1942-43, when the Japs were vastly superior to us on the sea and in the air, it took us 15 months to recapture islands and parts of islands dotting an area slightly more than 400 miles in length. By leapfrogging with preponderant air and sea strength, coupled with a wealth of equipment and trained soldiery for amphibious landings, the Allies have been able to race westward across 3,000 miles of blue water to Japan's front door since the turn of this year.

— limit of the Jap advance. Here and at Port Moresby, New Guinea, the Allies began their campaign of reconquest

2 The Gilberts were steppingstones. By-passing the heavily fortified eastern chain of the Marshalls, we seized the anchorage of Kwajalein, took Eniwetok for an air base

3 Meanwhile, the lower jaw of the pincers was moving. Successive westward stabs isolated the Jap garrisons scattered along the north coast of New Guinea

4 Our campaign on New Britain, beginning with Cape Gloucester helped neutralize Rabaul. We took the Admiralties to outflank the "Jap Pearl Harbor" at Truk

5 Now we could launch attacks on the Dutch East Indies with safety. Japan's star of empire in the South Pacific faded. The Philippines were vulnerable by air

6 Leaving Truk to be reduced by planes and submarines, we struck west into the Marianas. Thousands of Jap troops were sealed off in many island pockets

7 Sea and air control of the western Pacific were ours. Japanese in the eastern Philippines took alarm. Supply lines to the vanishing Jap "empire" were breaking



Map courtesy of Yank, The Army Weekly

Leapfrog conquest of the western Pacific lays Japan itself open to bombing from new island bases as well as from China. Flying Fortresses and Liberators from the east can join up with B-29 Superfortresses from the west to pound military and industrial targets in the Land of the Rising (7) Sun. As a result of this two-way aerial assault, it may be possible to bring Japan to her knees without landing a man on her home soil. Map shows hunting ground of our bombers

"mandated" Marshalls and buttressed it by seizing the Gilberts. They had even moved into atolls in the Ellice group to make air forays against our shipping in the seaway between the Phoenix Islands and Samoa.

Somewhere the Allies had to establish a defense line. Somehow they had to maintain the tenuous shipping route from Hawaii by way of Canton Island, Samoa, and the Fijis through New Caledonia to Australia. If that were broken, Australia probably would fall into the Japs' hands like an overripe apple.

Two events helped. The Battle of the Coral Sea on May 7-8 prevented the capture of our meager foothold on New Guinea at Port Moresby. The Battle of Midway, June 2-6, the first decisive defeat for the Jap Navy in 350 years, probably saved Hawaii. The Coral Sea and Midway actions reduced the Jap carrier-borne air strength by perhaps 500 planes, the equivalent of 5½ to six air groups. Another enemy air group was lost in the Battle of Santa Cruz Island in October.

We manufactured a third helpful event almost out of whole cloth. That was Guadalcanal. When U. S. Marines began storming the white beaches of Guadalcanal and

neighboring Florida island on August 7, it was a move of desperation. Maybe we could hold the Japs there. If not, maybe we could hold them in the New Hebrides, 600 miles to the southeast.

We held them.

Guadalcanal, at the start, was a purely defensive base. But when, in February 1943, organized resistance on the island had ceased, a plan had taken shape. Guadalcanal would be a springboard for an offensive. The Solomons would be neutralized. Rabaul would be isolated. Already we had made a mild start toward booting the Japs out of that part of the Pacific. We had landed on Funafuti and Nanomea in the Ellice group.

Now questions were being asked in Washington. Did the United States intend to claw its way back to the Philippines and the China coast and attack Japan by recovering every Jap-infested island on millions of square miles of ocean as Guadalcanal was recovered?

The official answer was not forthcoming for a long time, but leapfrogging was part and parcel of our plan. To leapfrog meant that we had to establish control of the sea. It meant more. It meant decided superiority



HOW THE

BATTLESHIPS _____

AIRCRAFT
CARRIERS _____

PLANES _____

CRUISERS _____

DESTROYERS _____

SUBMARINES _____

TRANSPORTS AND
AMPHIBIOUS CRAFT _____

America's naval might was a decisive factor in the march toward Tokyo. Control of the sea was the prime requisite in our leapfrog strategy. Without it, we could not have dared to leave enemy forces in our rear. Ships sliding from the ways of our yards at miraculous speed gave us the necessary preponderance of power and furnished the craft needed for amphibious war

in submarines and a wealth of landing craft—transports, ship-transported assault boats, and ship-transported amphibious assault vehicles. Finally, it meant control of the air.

It was air power that had given the Jap drive its impetus and it was air power that now could pocket large enemy garrisons while we moved on to other conquests.

It took time, but we got everything we needed. And in the process of getting it we smashed the first sizable segment of Jap resistance. The Solomons campaign should go into the history books as a classic piece of military strategy.

The Japs fought bitterly. Into Rabaul—short of Truk itself, the finest of the Japs' Pacific outposts—moved an unending stream of airplanes and supply ships.

"It would take the combined fleets of all the Allied nations," remarked an intelligence officer during the course of the air assaults on New Britain, "to reduce Rabaul. But it can be reduced without frontal assault."

It was. Four days after the first U. S. air strike at Truk the last Jap airplane disappeared from New Britain. Rabaul had been isolated. The Japs knew the jig was

up. It had been leapfrogged by Allied landings at Cape Gloucester, progressive amphibious stabs along the north coast of New Guinea, investment of the Admiralty Islands, seizure of the Marshalls, and the neutralization of the Solomons.

But that's getting ahead of the story.

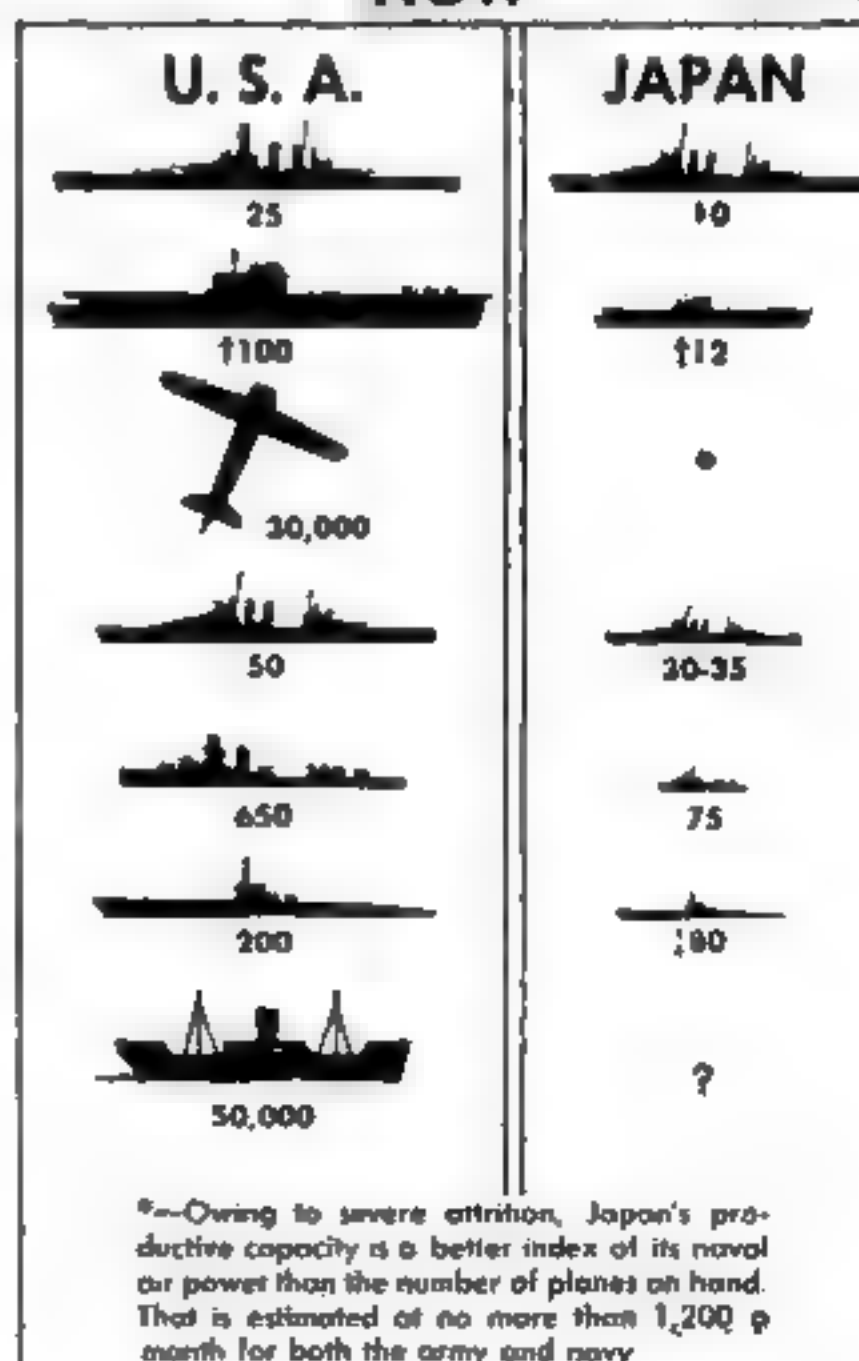
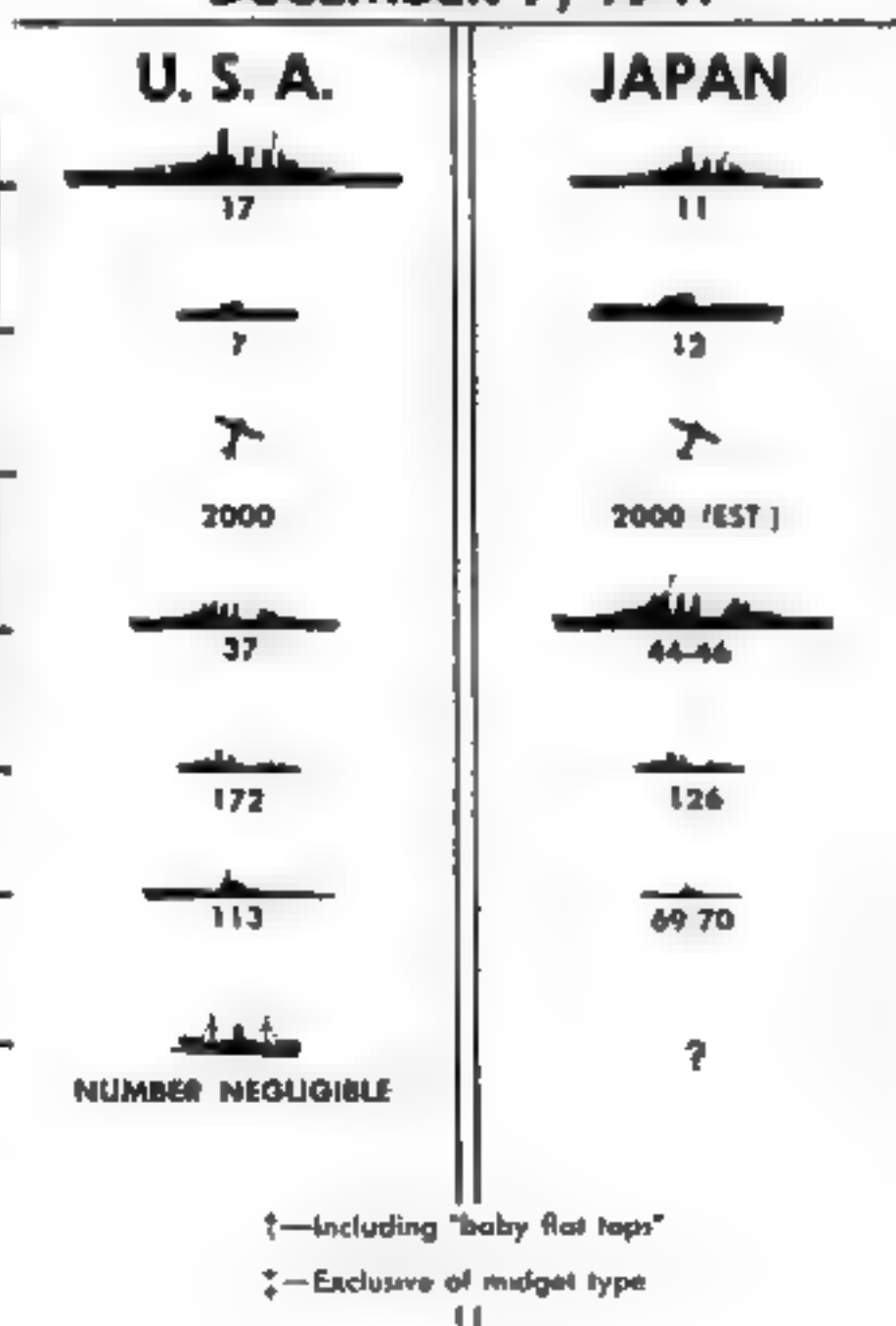
In the march up the Solomons (see map, page 67) Bougainville provided a near-perfect example of the amphibious landing tactics. Excepting Tarawa, where we learned a costly but valuable lesson—that nothing less than the whole book must be thrown at the Jap in preinvasion bombardment—Bougainville wrote our best primer for future operations. This is the way it worked:

For days preceding the landing we sluiced bombs onto the enemy's airfields, particularly those on the perimeter of Rabaul and in the Buin area, to neutralize them. Accompanying that were bombardments of shore installations, including those in the Shortland Islands, by light cruisers and destroyers. That was telegraphing our punch in advance, but a smartly executed diversion confused the Japs. We landed paratroopers on Choiseul from boats about a week before. (Continued on page 221)

BALANCE OF NAVAL POWER HAS TIPPED

DECEMBER 7, 1941

NOW



Can We Ever Fly

A seemingly impassable barrier blocks the way to higher plane speeds. Can we hurdle it? Our aviation editor gives his views.

By C. B. COLBY

Drawings by STEWART ROUSE

DESPITE glowing newspaper reports, man cannot now fly at the speed of sound. In fact it is doubtful, according to the best authorities, that man has ever closely approached sonic speed (764 m.p.h. at sea level and 664 m.p.h. at 40,000 feet), let alone attain or exceed it. Speeds of over 500 m.p.h. in level flight are a serious challenge to design and power-plant engineers. Even in a terminal-velocity dive (straight down with all stops open), it is doubtful that any pilot has attained the speed of sound.

There are two reasons for our inability to hit the speed of sound with present-day aircraft: First, the lack of power; and, second, a little gadget called a Mach (pronounced mock) number. The second reason is the more important, for it is responsible for the first, and so, let's delve into this Mach business.

It is merely for convenience that there is such a thing as a Mach number. It represents the relation of any speed to the speed of sound. For example a Mach number of .5 means that the speed so described is 50 per cent of the speed of sound.

The importance of the Mach numbers is that when an object begins to climb the speed scale up toward the speed of sound, many things can happen; the Mach numbers indicate at what point on this scale various things can be expected. For example, when the Mach number of a plane reaches .5 we run into what has been called compressibility.

Compressibility is that point at which an object begins to make waves in the medium through which it is passing. A boat moves

SHARP, THIN WING EDGES



TWIN-CHAMBERED ROCKET ENGINE CONTINUOUSLY FIRES AN EXPLOSIVE MIXTURE OF FUEL AND OXYGEN BY ELECTRIC IGNITION



SPECIAL SPOILER-TYPE CONTROLS FOR SUPERSONIC SPEEDS

ORDINARY RUDDER, ELEVATOR, AND AILERON CONTROLS WILL NOT WORK IN EXTREME AIR TURBULENCE BEHIND SHOCK WAVES PRODUCED AT SUPERSONIC SPEEDS ---

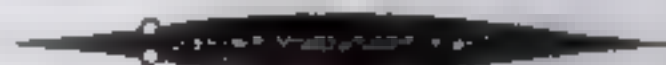


SO SPOILERS ARE USED AS CONTROLS. THEIR DAMLIKE ACT ON PRODUCES SHOCK WAVES TO DESTROY LIFT AS AILERONS OR CAUSE WING-TIP DRAG AS A RUDDER

SHOCK WAVE TURBULENCE

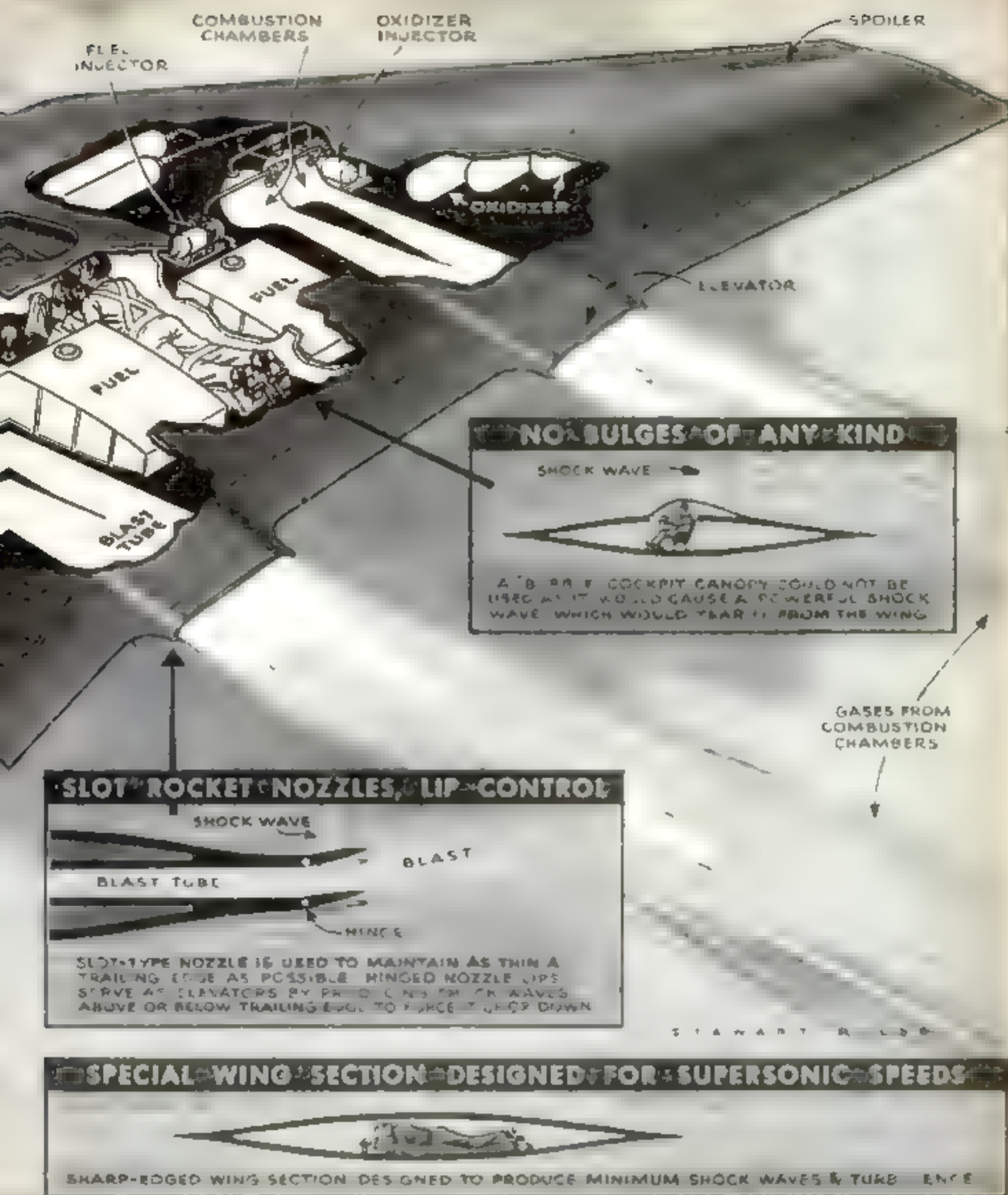


AS AILERON-TURBULENCE DECREASES LIFT

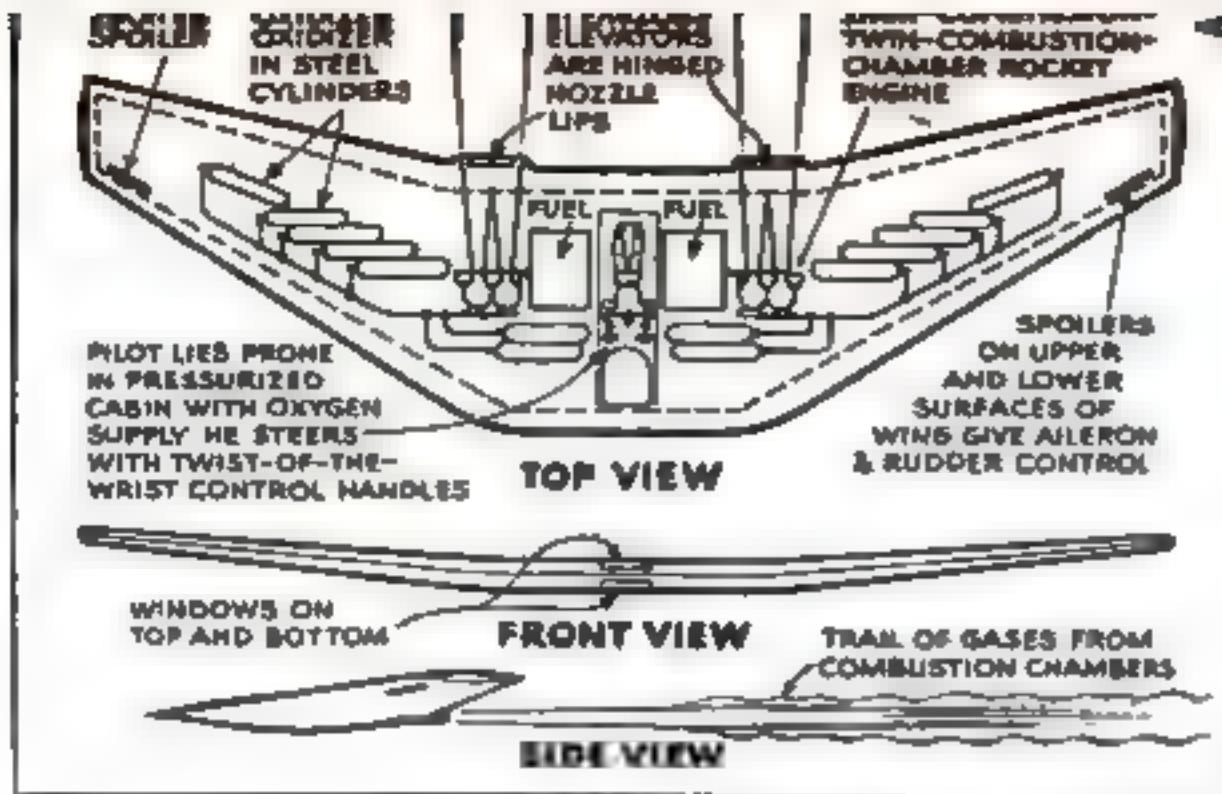


AS RUDDER-TURBULENCE INCREASES DRAG

Faster than Sound?



SUPERSONIC PLANE? Nobody has ever seen an airplane capable of equaling the speed of sound. However, we asked staff artist Stewart Rouse to give us his conception of such an aircraft, based on the aerodynamic problems involved. Taking a modern plane, he eliminated the features that would bar supersonic flight. Flying-wing design was adapted to solve the turbulence problems presented by a tail. A jet engine removes propeller worries and gives the needed power. Cockpit bulge is eliminated by putting the pilot inside the wing—prone position helps him stand maneuvering strains. Turbulence, chief foe of supersonic flight, is harnessed for control. Rouse admits one flaw: this plane could maintain flight **ONLY** at or near sonic speed. He doesn't say how you would get the thing off the ground or bring it down again.



"THREE-VIEW" shows novel shape of sonic plane. Dotted line in top view indicates extent of cast-steel, razor-sharp wing edge. The sweep-back gives longitudinal stability. Note clean front view and unusual side view

power. Making waves takes power, too, whether in a boat or in the parts of a plane. In fact, it takes such power that a plane can reach a point where it can not go any faster without a staggering increase in power.

For example, let's take a plane weighing 10 tons, with an engine of 5,000 hp., flying at a speed of nearly 500 m.p.h. At this speed, the air going over and around parts of the plane has already reached the speed of sound. Waves of compressibility appear in many places on its surface. These waves prevent the plane from going faster, for they need more power to drag them along through the air. We cannot just add another 1,000 hp. and reach 600 m.p.h. We will have to add 37,000 hp.

ahead slowly through the water, and no waves appear. It moves faster, and waves begin to stream around it, caused by the hull pushing ahead too fast for the water to part, let the hull pass, and then flow together behind it. There is a critical speed for every object, at which these waves appear.

A boat with a sharp prow can reach a higher speed before the waves begin to appear than can a square-prowed barge. Even the latter can move without waves up to a certain speed, for any object moving through a liquid is preceded by a compression wave. This compression wave prepares the medium for the passage of the object causing the wave.

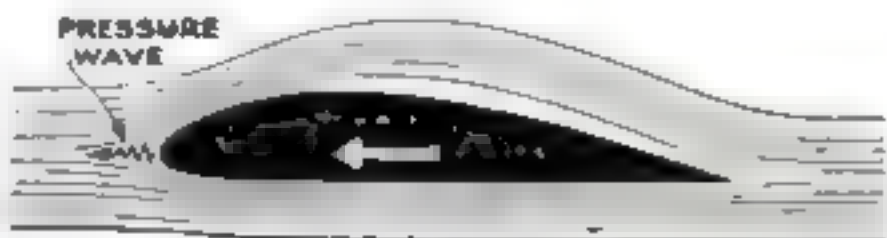
In the case of an object such as an aircraft, projectile, or propeller moving through the air, this pressure wave that "runs interference" for the object moves at the speed of sound. The air entered by the pressure wave is prepared so that it will part and flow about the object and then recombine with the air particles behind.

We also know that air flowing about any object must speed up and then slow down again to let the object pass. This may be an engine cowl, wing, tail, or cockpit cover. At about a Mach's number of .5 in an aircraft's speed, some of the air passing over parts of the plane's surface has already reached a higher Mach number, for it has had to go much faster to get around these parts—although the plane itself has not anywhere near approached the sonic speed. What happens? Plenty!

Instead of flowing smoothly around the part, the air is smacked against it with such force that waves of compressed and rarefied air in alternate bands are formed at the point of impact. When an object is traveling at the speed of sound, which is also the speed of a compression wave, it is easy to see what this can mean. It is like a football player who cuts ahead of his interference and is tackled. He keeps his feet and tries to drag the tackler along with him. This takes



SHOCK WAVES created when a modern high-speed wing meets an airflow of only 580 m.p.h. are shown by this Schlieren wind-tunnel photograph made by the N.A.C.A. at Langley Field, Va. Note how the waves stand out vertically from the wing surfaces. Sketch below shows the normal flow of air around a wing, with pressure wave clearing way



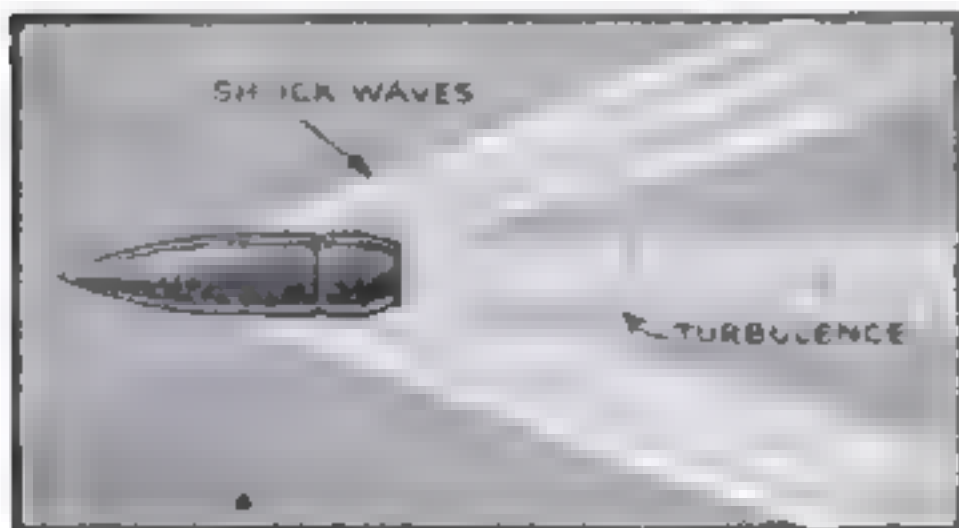
to get that additional 100 m.p.h. This is obviously an impossibility in the case that has been cited.

It is not attaining the speed of sound that causes trouble, but the compression waves and resulting turbulence when the air particles have to slow down again after the airfoil has passed. The air passing over the curve of the front of the airfoil starts off at great speed which almost instantly reaches sonic velocity and then runs smack into the slow-speed air in great turbulence behind the wing section. The result is a shock wave at the slow-down point.

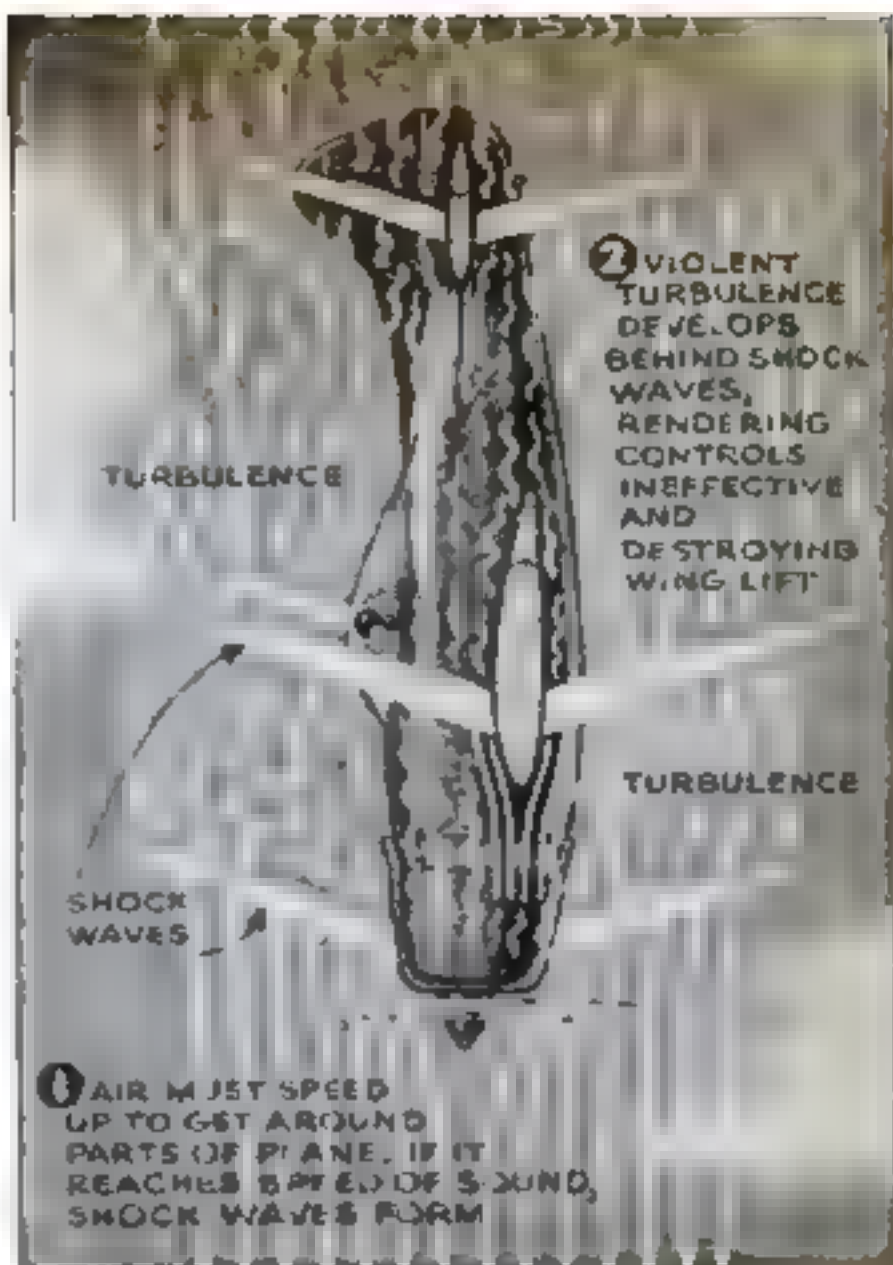
If the speed of the wing were less, the air would be able to pass smoothly around it without separating from the surface. Compressibility difficulties are, in general, caused by trying to get too much lift out of a given airfoil at a given speed. The resulting turbulence and loss of lift are the same as if the wing were flying too slowly and stalled.

This turbulence does not really stream out behind the wing. It merely remains for a time after the plane has passed, in the manner of dust after a car on a country road, and finally settles back into a state of calm. And, just as some of the dust is carried along with the passing car, some of the air particles are carried along with the plane to add to the general turbulence around the area.

The effect on the tail surfaces of the plane is like that on a small boat being towed behind a bigger and faster boat which makes waves that do not fit the hull of the smaller boat. Turbulence resulting from the passage of air through the shock wave about the main wing and fuselage fittings smacks into the tail surfaces, making them inefficient and even subject to damage. A small angle about the cockpit canopy, control-surface hinge, or aerial mast will build up an airflow to a point of compressibility or wave-making air speed, with the result that a shock wave is formed which may



BULLETS can travel faster than sound because they are solid metal streamlined shapes and can stand the pressures and shocks they encounter. The higher the speed, the more the shock waves slant to rear



A PLANE in a terminal-velocity dive cannot obtain the speed of sound. Drag produced by shock-wave turbulence holds its speed at a given point, usually well below the sonic level. Shock waves also kill wing lift and neutralize control surfaces

cause damage unless the fitting can take the resulting shock.

The problem for our engineers is to design aircraft and their parts to minimize this shock wave or postpone its formation to a higher Mach number. The general formula seems to be to reverse all streamlining. It is not quite as simple as all that, but it appears that reversed streamlining, with the pointed end foremost, will enable the object to enter the unprepared air with a minimum of shock, which may postpone the forming of the shock wave over the surface.

So far, supersonic speeds are relatively unknown except in propeller tips and bullets. Bullets, of course, can fly at supersonic speeds, but only for a matter of seconds. They can stand these turbulences, because they are solid structures, perfectly streamlined, and driven by the energy of an outside and left-behind power—gunpowder in explosion. Were it not for the fact that projectiles are primarily designed for penetration rather than for velocity, their shape might indeed be altered for even more speed. In fact, false streamlined noses have been added to certain types of long-range shells to give them higher velocity and added wallop.

The smooth skin of the projectile helps, of course. In the same way, butt joints, polished metal surface (Continued on page 234)

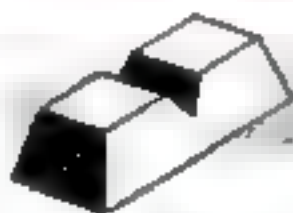
March of Science



CHEMISTRY

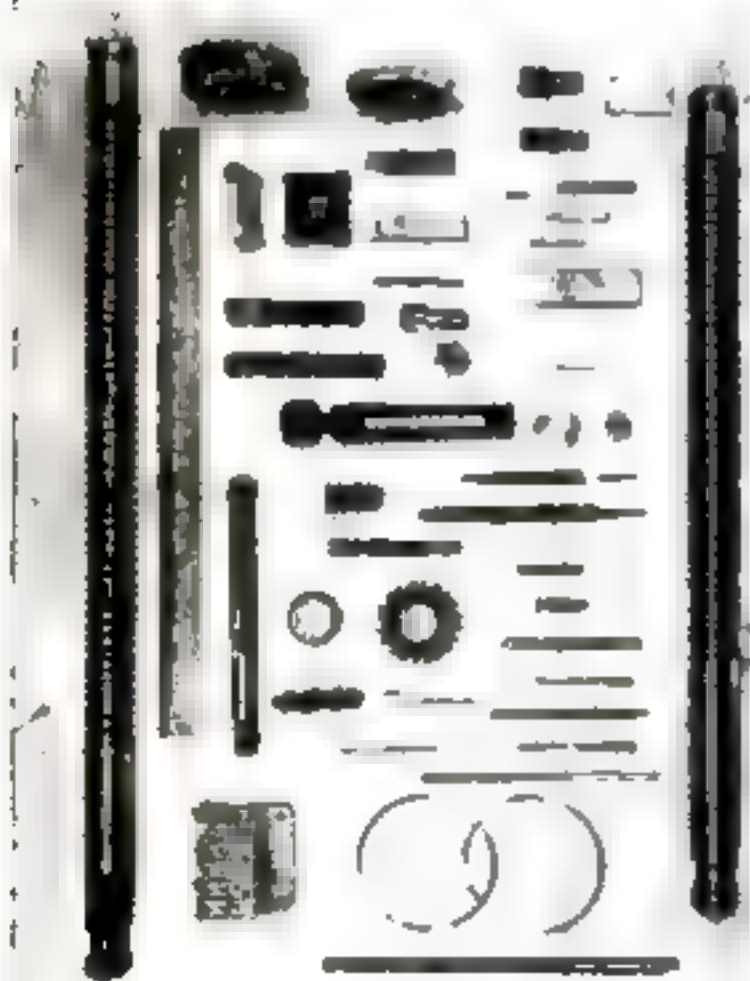
THE MISSING LINK in synthetic plastics is a preformed product, announced by Westinghouse, that fills the gap between the plastics that are easily molded but have little strength and those of great strength but difficult to mold. The new material is so strong that a bar one inch square resists a pull of 16,000 pounds; and the substance can be shaped roughly to its finished form before the customary application of heat and pressure. Weighing only half as much as aluminum alloys, it may have future applications to airplane construction.

Pulp made up of 97 percent water and three percent fiber and resin is sucked by vacuum against a screen mold to make a cone (right) of preformed plastic. Photo above shows how the plastic cone is placed in a forced-draft oven by an experimenter for drying process



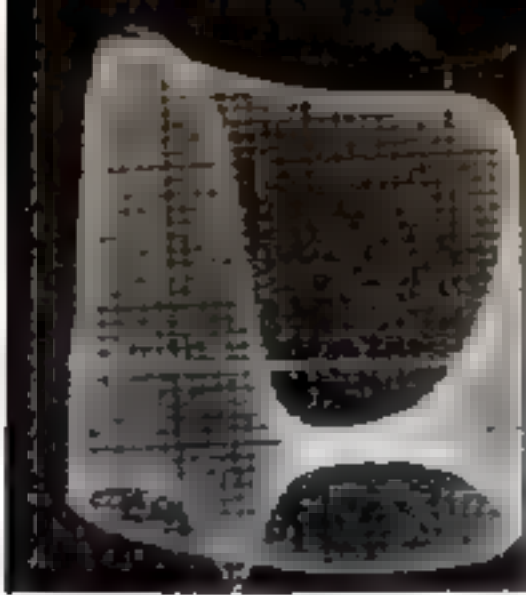
METALLURGY

CHROMIUM PLATING has increased the life of machine tools from three to 50 times, according to Axel Lundbye, the discoverer of a new process, and the manufacturers who have used it. Formerly chromium peeled from tool steel under pressure. Merely giving the chromium-plated tool an hour's bath in hot oil prevents this, Lundbye finds. Later treatment expels hydrogen impairing bond.



Samples of chromium-plated tools, and the hot-oil bath employed in the Lundbye process





The Cyclograph (right), by showing luminous patterns on a ruled scale in the window of a cathode-ray tube, tests metals. Upper picture shows brittleness, while lower photo indicates adequate case-hardening



ELECTRONICS

TEST FOR METALS. Simply by inserting ammunition or other metal products in a magnetic circuit, a workman

or technician can now perform a chemical analysis, determine whether heat treatment has been properly carried out, and measure thickness of plating or of tubing walls. So rapid is the process that entire batches, rather than random samples, may be inspected. The instrument used is called the Cyclograph, which was developed by the Allen B. Du Mont Laboratories, Passaic, N. J. Results show as a luminous pattern superimposed on a ruled scale in a window of a cathode-ray tube. The instrument performs both qualitative and quantitative metallurgical tests on either ferrous or nonferrous metals. Some of the tests have never before been possible without destroying the specimen. The electronic mechanism is located behind a locked panel, and the key is available only to a skilled technician.



OPTICS

A LIGHT BENDER for scientific research and commercial use is a refractometer of extreme precision announced by the Spencer Lens Co., Rochester, N. Y. Instruments of this type measure the amount by which light is "bent" or refracted in passing through material under examination. Application of the principle enables a chemist to identify many transparent liquids and solids; to determine the optical qualities of glass and of plastics; to detect dilution of milk; and to measure the strength of sugar solutions.



Scientific and commercial testing by means of bent light is accomplished with the aid of this new and extremely precise refractometer



ROCKET POWER helps heavily loaded planes get off the ground with short take-off runs in tests being made by the AAF Materiel Command at Wright Field, Ohio. At the left, a B-25 Mitchell medium bomber is getting a lift from droppable rocket units attached to the undersides of the wings. Attack planes, such as the A-20, have been tested with fixed rocket units discharging gaseous flames from the rear of the engine nacelles. Experiments are reported as successful.



LIGHT BEAMS on stilts, to guide planes on snowbound runways, are proposed by the Civil Aeronautics Administration. In the northern U. S. and Canada, the snow is not removed, but rolled hard, obscuring marker lights. Experiments at Laconia, N. H., suggest plastic extension rods to carry the light beam from the buried marker bulb to the top of the extension, and reflect it in both directions along the runway. Equipped with reflectors and prisms, the rods would be adapted for screwing into the fixtures of the marker bulbs, as shown at left.



PUNCTURED by bullets or flak, steel bottles of aviation oxygen or of carbon dioxide for fire fighting may vent their terrific internal pressure by exploding like bombs. Engineers of Walter Kidde & Company have developed a process of wrapping them with wire so a bullet leaves a clean hole.



TWIN ROTORS whirling at the ends of winglike pylons give a new twist to helicopter design in the Platt-LePage XR-1 now undergoing trials at Wright Field. The fuselage and tail are like those of a conventional airplane. A 450-hp. Pratt & Whitney engine, most powerful ever used in a helicopter, turns the two 30½-foot-diameter rotors. Craft weighs about 4,800 pounds.

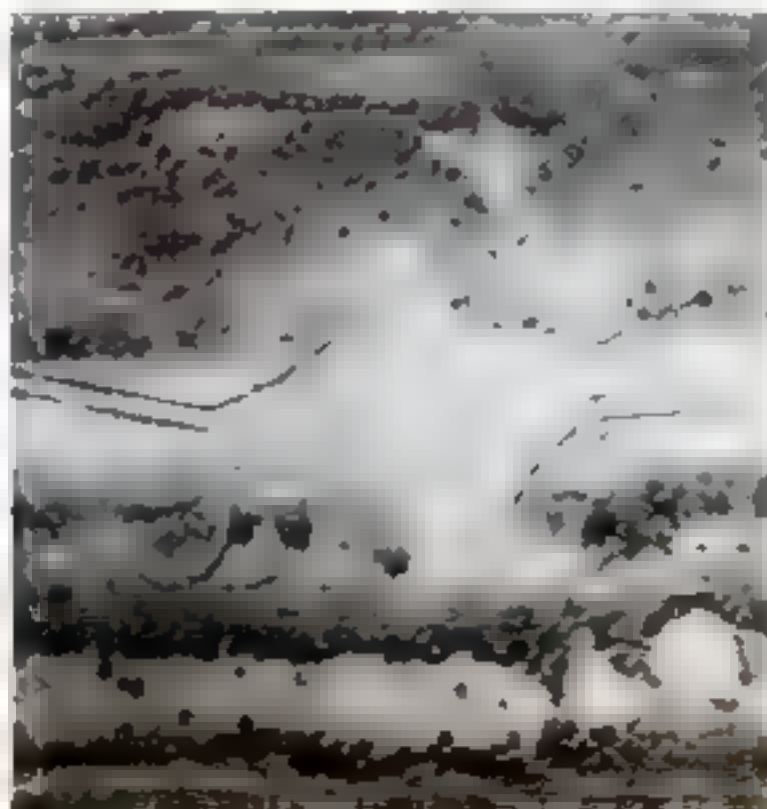
U.S. NAVY

PROPELLERS SERVE AS AIR BRAKES for the U. S. Navy's 1,000-horsepower blimp M-1, largest nonrigid airship ever constructed in this country. First of a number to be built for anti-submarine duty, the ship is said to be able to come to a quick stop in mid-air by reversing both propellers. When only one airscrew is reversed, the blimp turns on its own axis. Full power forward on both props, and it leaps ahead for a fast take-off or air maneuver.

The secret of the M-1's remarkable agility is the fact that the angle of its two variable-pitch propellers can be completely reversed by electric control. Thus, while they continue turning in the same direction, their propulsive force may be directed either forward or backward. Propellers of this kind have previously been installed on huge flying boats, but the M-1 is the first airship to employ them. One propeller is mounted on each side of the big blimp.



SPIKE BOMBING, which plants aerial missiles with almost incredible precision, has been helping to blast an Allied supply line through Burma to China. A major target was a railroad built by Japs in Burma to bring up reinforcements and war materials. Flying low to make hits between the rails, B-25 planes tried dropping standard 100-pound bombs with delayed-action fuses, giving the aircraft time to escape the blast. But the bombs tended to skip and explode wide of the mark. Resourceful airmen solved the problem by adding a sharpened spike to the bomb nose, so that it would dig itself in wherever it hit. The handmade improvement proved so effective that U. S. plants took over production. At left, below, a "spike bomb" almost scores a bull's-eye hit on the railway. The companion view shows typical remains. Now it's up to the Japs to figure out where to get new trackage. In the illustration at right, a photo of the new bomb is superimposed on a drawing of the spike that screws into the nose.



Photograph from U. S. Air Forces

M-4 MEDIUM TANK
WITH 75-MM. GUN

M-31 TANK RETRIEVER
WITH 81-MM. MORTAR

M-36 MOTOR CARRIAGE
WITH 90-MM. GUN

M-18 MOTOR CARRIAGE
WITH 76-MM. ("HOLE PUNCHER") GUN

M-24 LIGHT TANK
WITH 75-MM. GUN

Drawing by
B. G. SEIELSTAD

Secrets of Our New Armor

HERE ARE SOME OF THE FAST, HARD-HITTING
COMBAT VEHICLES THAT BEAT THE PANZERS

HOW have American tanks and tank destroyers been able to outblitz German armor at its own game? Correspondents recently learned the answer when the Army exhibited some of its latest combat vehicles, and revealed hitherto secret facts about them, at its Aberdeen, Md., Proving Ground.

Light U. S. tanks now pack the punch of former "mediums," and our General Sherman M-4 medium tanks have slugged it out on even terms with monster German "heavies" like the Tiger and Panther. Bigger guns are one of the reasons. Largest weapon ever carried by a medium tank is said to be a 105-mm. howitzer mounted on some of our M-4's. High muzzle velocity, and armor-piercing shells, account for the destructiveness of the 76-mm. "hole puncher" gun of

other M-4 tanks, and of the self-propelled "motor gun carriage" or antitank weapon M-18. Its big brother, the 90-mm.-gunned M-36, is called the world's fastest major-caliber tank destroyer. It pursues and knocks out heavy enemy tanks at 30 miles an hour. High speed characterizes the Army's whole stable of combat vehicles, and its tactics in their use. A novelty in American light tanks, the airborne 37-mm.-gunned "Locust," lands from a glider and races along roads at 40 miles an hour.

Among special-purpose vehicles, tank-recovery cars dash onto battlefields to haul out disabled tanks, either by towing them or by taking them bodily aboard. From the high-speed armored utility car M-20, field commanders direct advancing motorized forces,



M-4 MEDIUM TANK
WITH 105-MM. HOWITZER

M-5 LIGHT TANK
WITH 37-MM GUN

"LOCUST" AIRBORNE TANK
WITH 37-MM GUN
(GLIDER IN BACKGROUND)

M-8 ARMORED CAR
WITH 37-MM GUN

M-20 ARMORED UTILITY CAR
WITH .50-CAL. MACHINE GUN

AMPHIBIOUS
WEASEL

ACTUAL SIZES OF GUN CALIBERS IN MM.





American invaders have used the Beaver to land vehicles of all sorts on enemy shores. They make beach-heads possible where there are no port facilities. Workmen who never saw the sea have helped build a huge fleet of the barges. Manufacturers say that, with minor changes, the new craft can be used for river shipping



THE BEAVER, LCM-3, is a Diesel-powered barge for landing medium tanks. Built by the Warren City (Ohio) Manufacturing Co., and tested in a 34,000-gallon tank of water, these craft have been shipped to the sea on railroad cars (above). The Beaver is 50 feet long, 14 feet wide, and weighs about 30 tons. Even though the barge is placed on its side, with landing ramp and pilot house removed, low bridges and tunnels must be avoided.

TO HIT THE TARGET with a projectile from a fieldpiece, range and deflection must be figured accurately. This is done with a range-deflection fan (top, right) and protractor made of a rigid plastic material that does not change in size or warp when subjected to extreme temperatures. The numbers are printed on these instruments in black. The printing then is covered with a transparent film of the vinyl type to protect it from rough weather and wear. Warped or illegible scales might spoil the artillerymen's aim, causing them to miss their target by a wide margin.



SEAGOING DRY DOCKS have followed the U. S. fleet in the Pacific. They are used to repair damaged ships on the spot. The Navy has spent \$300,000,000 on floating dry docks, some of which are bigger than battleships. They can be submerged to take a vessel aboard. Then, when it is in position, water can be pumped out and the dock will lift the

vessel out of the water for maintenance or repair work. This photo shows a new submarine, built inland, being carried down the Mississippi in one of these big floating docks. Some of the new docks are self-propelled; others must be towed. They enable our fleet to operate far from fixed bases, thus increasing its striking range.



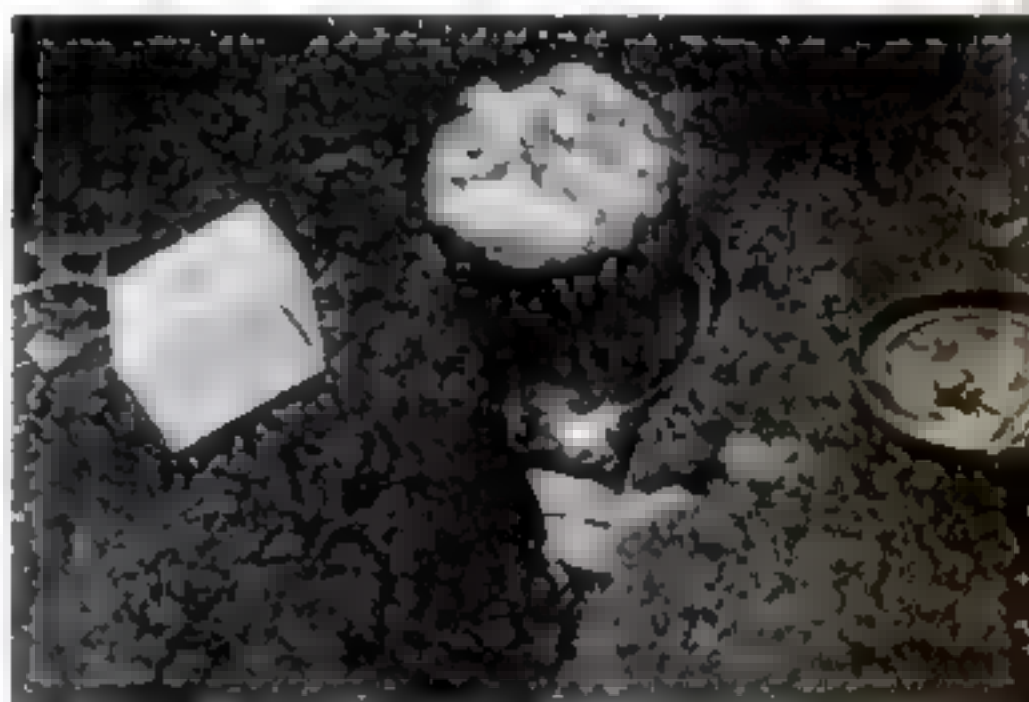


STEWART ROUSE

FASTEST CONTROLLED FLIGHT ever made is credited by American flyers to a rocket-propelled German fighter plane, the Messerschmitt ME163. This is a **POPULAR SCIENCE MONTHLY** artist's conception of the speed demon, based on reports from men who have seen and battled it over the Reich. Its bar-

rel-like fuselage is only about two thirds as long as the width of its tapering wings. The propellant leaves a dense, white smoke or condensation trail behind the dark, dull-finished fighter. From this puffy trail, pilots have concluded that it operates like a glider between bursts of speed.

FOOD IS WARMED (right) for the modern soldier by a square candle composed of refined paraffin wax with a high melting point, and wood flour. This candle will ignite readily even after being submerged in water for several hours. It was developed by the Army Quartermaster Corps for heating the meat components of combat rations in the field when gasoline stoves and fuel to operate them are not accessible.



BIGGEST PROPELLER ever used in flight in this country is the new 18-foot, 2-inch Curtiss electric model at left, used in service tests on an Army bomber. It harnesses 3,000 or more horsepower in the substratosphere. Hollow-steel blades make it 20 percent lighter than a comparable propeller with solid aluminum-alloy blades, and increase the useful load of the plane about 650 pounds. Beneath it is the first Curtiss electric controllable-pitch model, which was made 16 years ago.



TWO STEERING WHEELS, one at the front, one at the rear, enable the crew of this British armored car to beat a fast retreat merely by reversing the gears and then steering from the back end. Designed especially for difficult terrain, it can be tilted 60 degrees without toppling. Armament includes a two-pounder cannon and two machine guns.

CURRENT CATCHER. Looking like the work of some mad inventor intent on building a giant spider web of steel with which to catch monstrous flies, the huge copper "threads" of this collector for a synchronous converter are shown stretching out to snare electric current. The charges that they catch are carried to a central point where they are then converted from alternating to direct current. George Gimera, a worker at the East Pittsburgh Works of the Westinghouse and Electric Manufacturing Company, is shown soldering some of the collector's armature connections. It is reported that the collector will soon be put to work doing an important job in our war-vital aluminum industry.



BEFORE

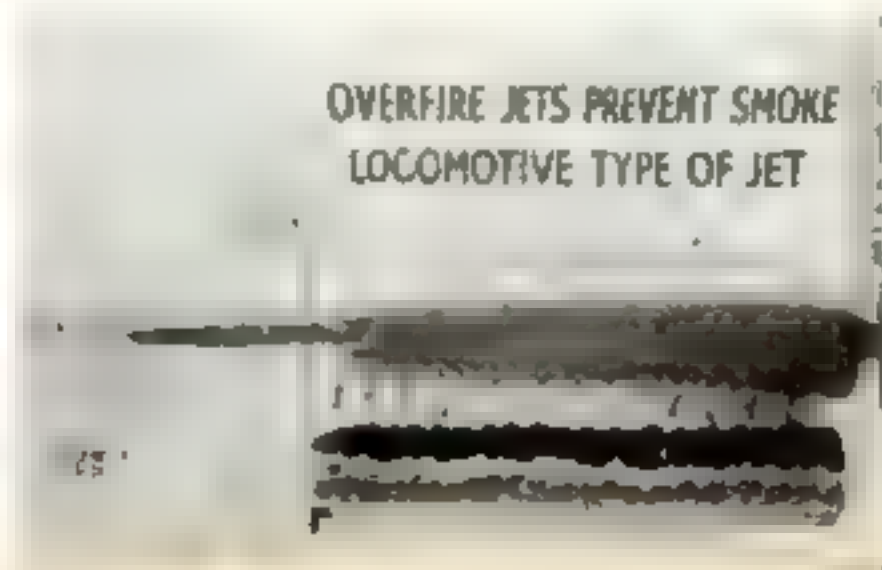


AFTER

SMOKELESS LOCOMOTIVES have now rolled on the scene as the result of air-jet installations that cause the unburned gases in the firebox to ignite rather than wastefully go up the chimney in smoke. Emitting streams of air over the fire at high velocity (as shown in the drawing at the bottom of the page) the jets force the unburned gases to mix with the air and thus become more inflammable. In the locomotive above, air jets have eliminated the engine's smoke in exactly five seconds. The device was developed by engineers of the Bituminous Coal Institute.



OVERFIRE JETS PREVENT SMOKE
LOCOMOTIVE TYPE OF JET



Inside Facts About the B-29

PRESSURIZED CABIN. The control compartment in the nose is connected with the gunners' compartment amidships by means of a tunnel passing above the unpressurized bomb bays. The opening behind the two officers' heads at right is an escape hatch. The drawing below shows the parts of the plane that are pressurized



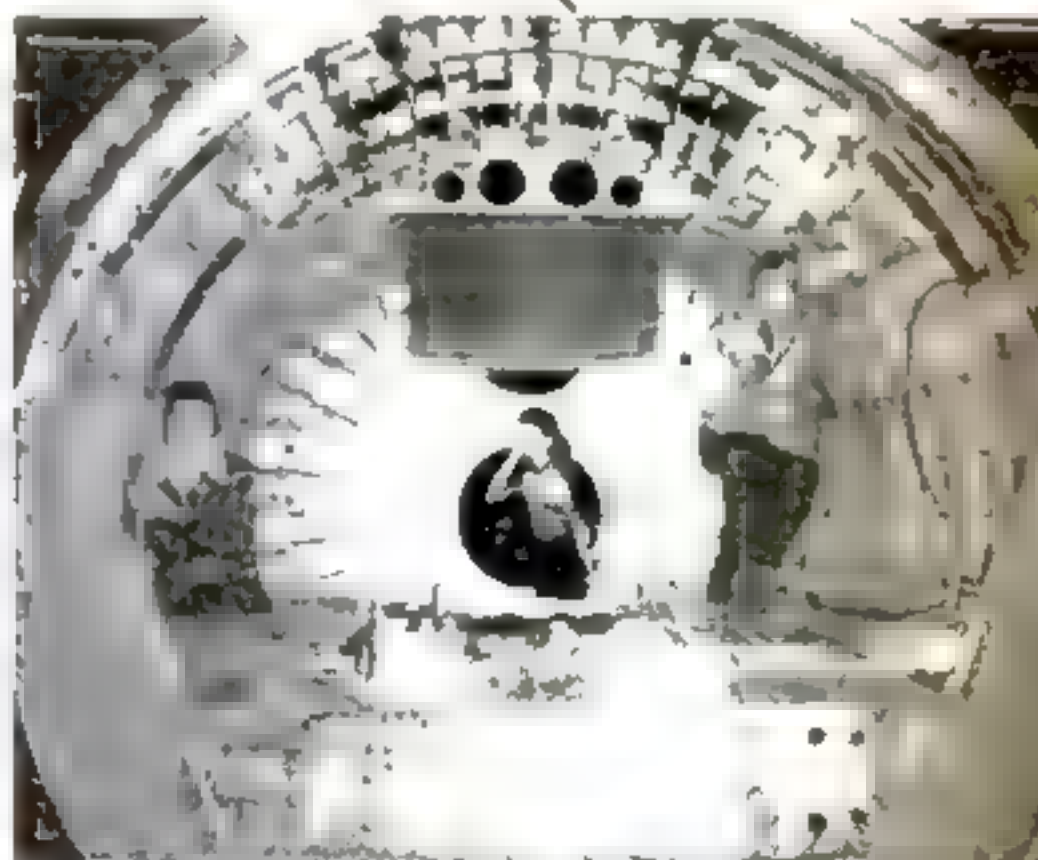
Interior of the control cabin is seen below, as Boeing workers add fittings. Pilot's position is in front of the riveter at right, the hatch at rear



GUNNERS' POSTS in the waist are tops in visibility. This photograph also shows the clean aerodynamic lines of the tapering fuselage, and the towering tail the B-29 inherited from the Fortress

GIANT PROPS—the biggest ever used on a production model—dwarf a tiny little Culver parked beside the mammoth Superfortress. They harness the drive of the four 2,200-hp. Wright Cyclone engines, each fitted with two superchargers

OCTOBER, 1944



ROBOT MATHEMATICIAN KNOWS ALL THE ANSWERS

Thirty-five tons of dials, wheels, and wires knock out problems that would take the best human expert a lifetime.

SOME boy may soon work his way through Harvard University by watching a 51-foot switchboard all night in an air-conditioned basement. Behind its polished panels, electricity will be solving the longest and most difficult mathematical problems ever conceived. It will be doing everything that is known to be mathematically possible with such numbers as 12,743,287,341,045,502,372,098.

Even Commander Howard H. Aiken, U.S.N.R., the professor in charge of this 35-ton calculating machine, says he does not know what you would call a number that long. It is billions of billions.

But the young man running this figure factory will not need to be a mathematician. If anything goes wrong, a red light will flash, he will make a few simple adjustments, and the mountain of machinery

THESE ARE THE MACHINE'S MAIN OPERATIONS

PROBLEM

Numbers needed to solve a problem can be given to the calculator with these 1,440 dials. Additional numbers can be fed into the machine by means of especially perforated cards and paper ribbons

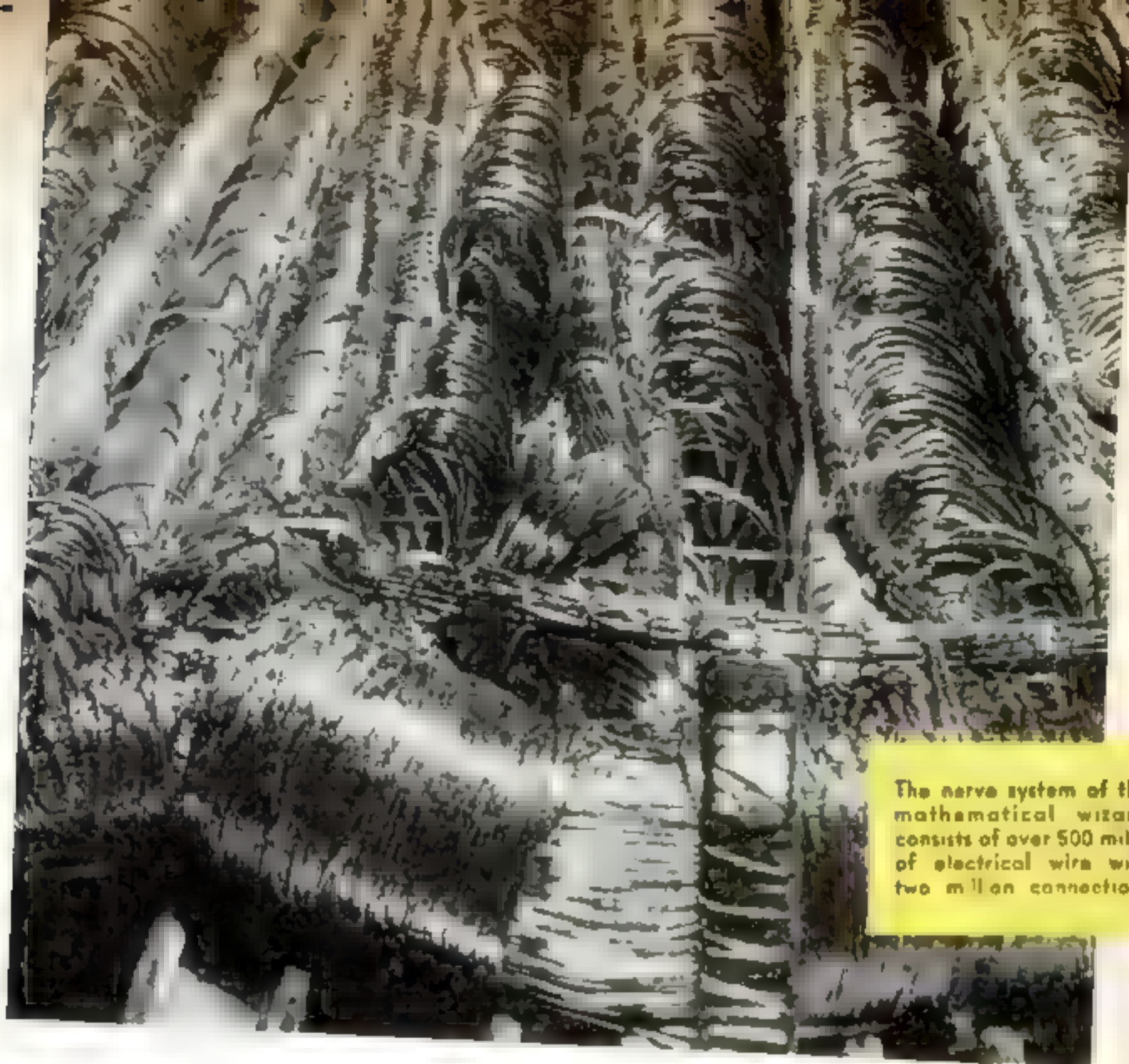
ARITHMETIC

Addition and subtraction take place here. Numbers also may be "stored" for future use in any of the 72 counters below. Each counter has 24 electro-mechanical wheels, capable of holding any number containing up to 23 significant figures

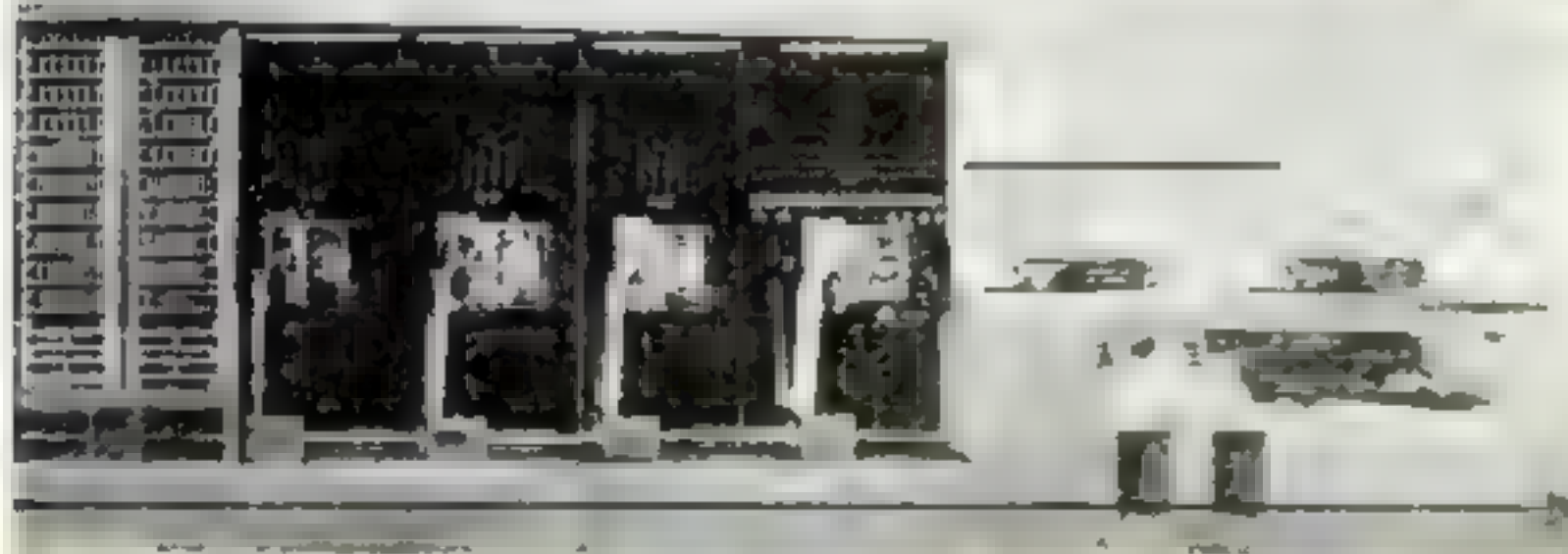
Multiplication and division are done here. Behind these counters is a mechanical multiplication table. To indicate decimal points, a set of electrical plugs is inserted in the appropriate holes, which are located directly below the counters



The extraordinarily complicated switchboard that you see directly above is the face of the world's greatest calculating machine—a 35-ton monster now occupying a soundproof, air-conditioned basement room at Harvard University. It will solve almost any known problem in applied mathematics, with results readable to 23 decimal points. Now working 24 hours a day for the Navy, it will, in the postwar era, be used to probe into vast unexplored fields of mathematics and other sciences. Its calculations may affect many of our basic concepts of the universe, and eventually our personal lives. The machine was built by I.B.M. in co-operation with H. H. Aiken, Harvard engineering professor, who says he can't figure his income tax



The nerve system of the mathematical wizard consists of over 500 miles of electrical wire with two million connections



8 FT.

HIGHER MATHEMATICS

Work involving logarithms and functions in trigonometry and calculus is done here. Beside counters are three interpolators. Three basic "math" tables are kept stored in machine. More can be put into interpolators on perforated ribbons

CONTROL

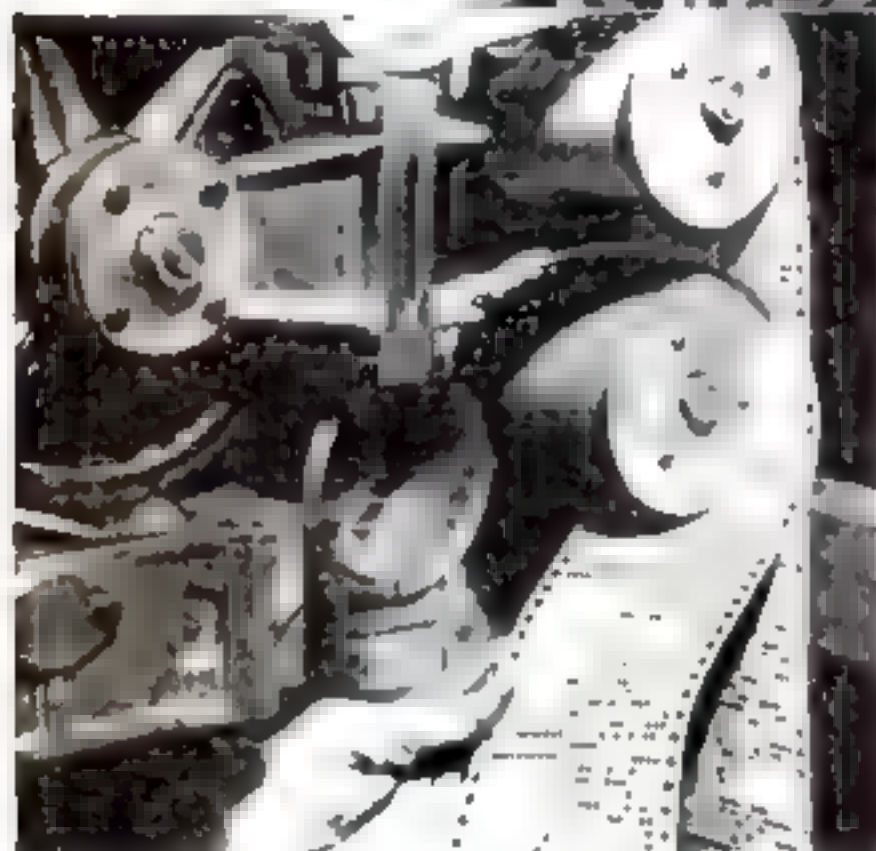
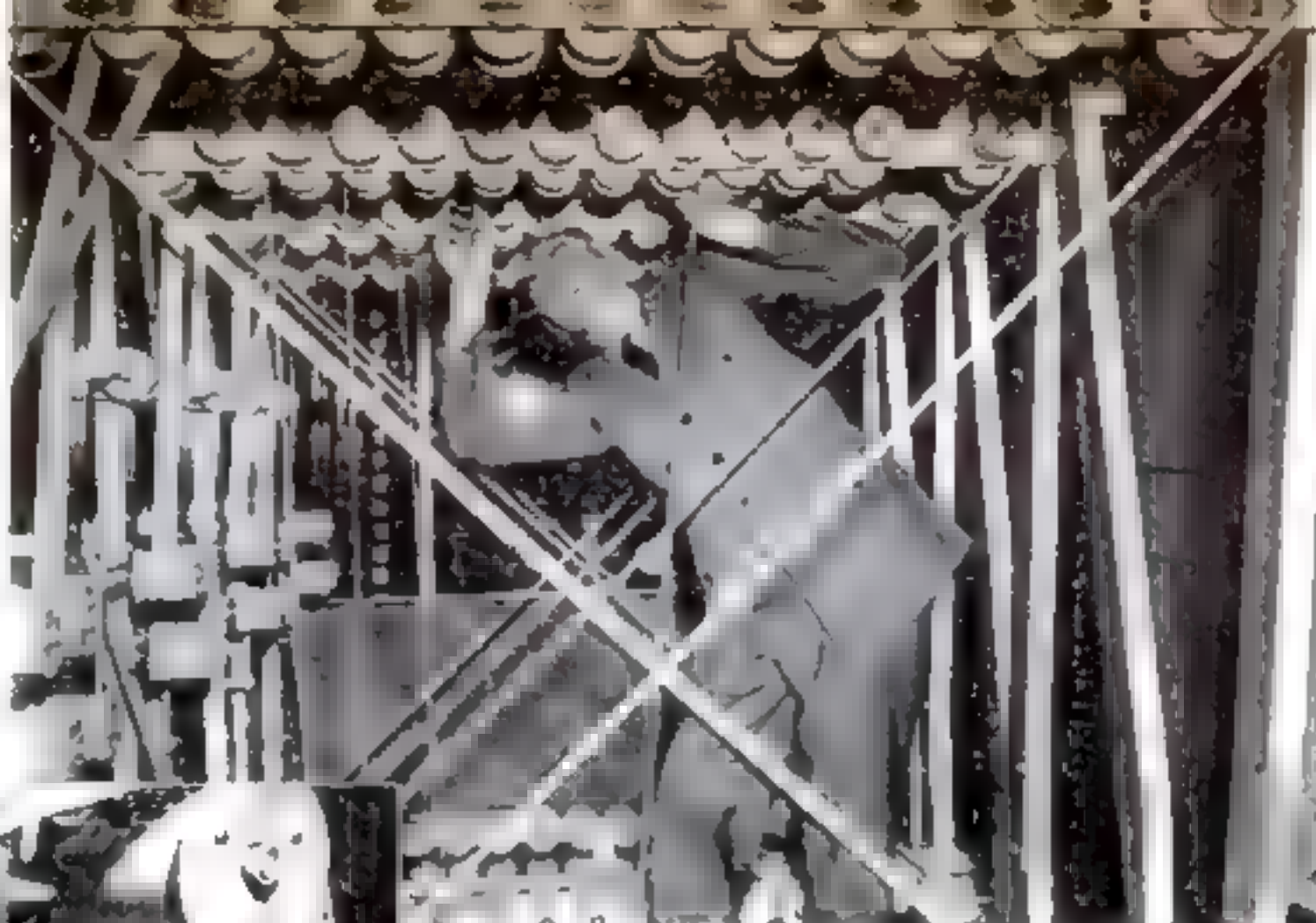
Instructions as to what to do with numbers are given to machine on perforated control paper ribbon. This tells the machine how mathematician in charge wants the problem to be computed

ANSWERS

Typewriters automatically write results of machine's calculations. Apparatus for running punched cards in and out of the calculator is beneath typewriters

Professor Aiken, now a commander in the Navy, examines some of the spools at the back of the machine. Ribbons bearing tables used to solve problems in higher mathematics are carried on these spools

This close-up shows how, from perforated ribbons of paper, the machine reads the numbers it has been given to handle, as well as the instructions



A specimen of the control ribbon. The legend has been written merely to show the reader the type of instructions that the small holes in the middle of the ribbon give the machine



will go swiftly on with computations that professors have not lived long enough to complete.

Everybody's notions of the universe and everything in it may be upset by the columns of figures that this monster will type out. For the Automatic Sequence-Controlled Calculator will do scientists' tedious mathematical chores for them, and do such work about 100 times as fast as a man. Thus it will accelerate the exploration of nearly every field of knowledge.

The U. S. Navy is exploring oceans of figures with this mathematical dreadnaught now; six officers and six enlisted men are running it 24 hours a day. And Commander

Aiken will remain at Harvard after the war as director of a supercomputing laboratory to which scientists and engineers throughout the world will be invited to send their longest and toughest problems.

Eight years ago, when Aiken began work on mathematical plans for this machine, he supposed that only one such capacious calculator would ever be built. He could not conceive of there being enough work for more than one such giant. He holds no patent rights and expects no profit. But Harvard faculty members predict now that at least 50 enormous machines like this will soon be needed.

For the Babylonians, three was a good



Building the mathematical master mind took six years and cost \$250,000. Only one part of it, the mechanical multiplication table, is shown here being installed. If any part of the calculator fails during operation, one of a battery of red lights warns the attendant



Once the dials have been set and the perforated cards and ribbons introduced into the machine, it takes only one man to run the calculator. But it takes a crew of mathematicians to keep the hungry monster fed. Here one of them is puzzling out a list of answers

Photos by Paul H. Donaldson, Croft Laboratory, Harvard University

enough value for π ; now π has been figured out to 700 decimal places. Many more values used in scientific research and engineering must be ascertained to many more decimal places as the world progresses. The accuracy of weapons, the stability of airplanes, and the reliability of scientific instruments depend largely on mathematical calculations. This machine can determine differences mathematically that are too minute to be measured under any microscope or detected with any other scientific device now available.

Calculators like this can be used to give science periodic mathematical housecleanings. Errors and inadequacies in standard

mathematical tables can be detected and corrected. Already, Aiken and his assistants have found 11 major mistakes in a table prepared by a Japanese scholar and published in Germany in 1926. This table has been used in all countries for highly important mechanical and military calculations. At least 200 other such mathematical tables are being used constantly.

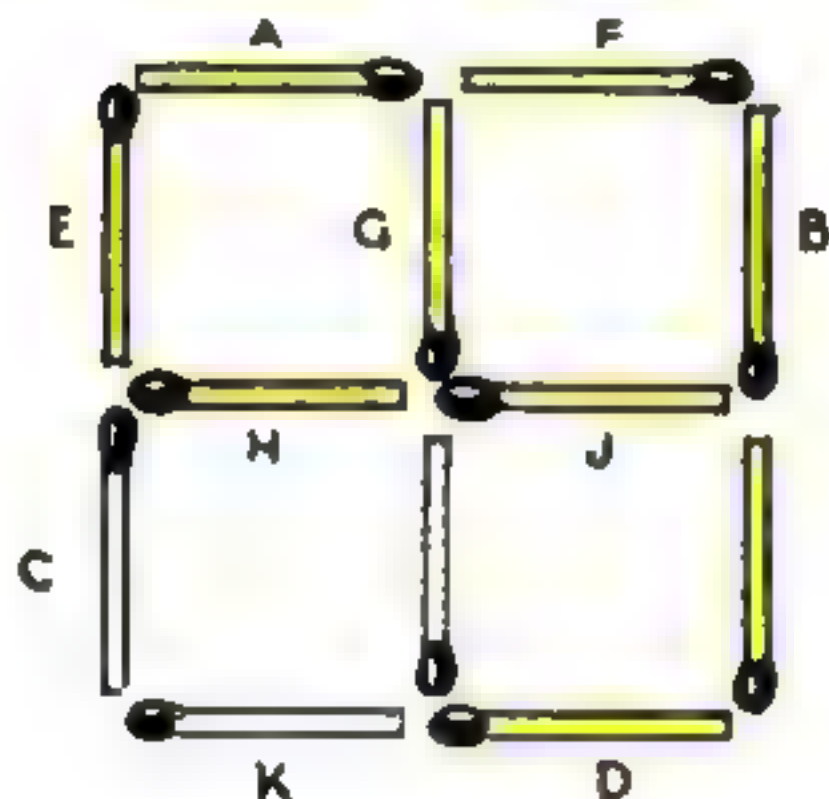
Dr. Bart Bok of the Harvard Observatory says that in astronomy alone there are enough postwar jobs for Aiken's robot to keep it grinding away for years. One of the first of these chores may be the compilation of new tables showing the motion of the moon.

Sir Isaac Newton's theory of gravitation was based largely on comparison of the moon's movement with that of bodies falling freely on earth. But the moon's course was charted only roughly; predicting its path involved more than 1,000 arithmetical considerations. The late Prof. E. W. Brown of Yale spent a lifetime working out new and more nearly accurate lunar tables. This machine could have made those computations in about one percent of the time the task took Professor Brown. Now the moon's motion can be measured with more precision, and the astronomers want still more nearly exact tables.

Another assignment for this portentous, timesaving contrivance may be figuring out the motions of the planets. Some of the most important dynamic equations of the solar system have not been solved yet, simply because there have never been enough mathematicians available. The solution of these and other such equations may affect the theory of relativity and other great scientific concepts.

Calculations made with this machine may tell the experts more about the motions of stars in spiral nebulae, about the oscillating or vibrating stars, about what goes on inside of stars, and about cosmic rays. Difficult problems in physics *(Continued on page 222)*

CAN YOU SOLVE THESE MATCH PUZZLES?



Reseating the Jury

1 Set out 12 matches so that they will form four squares as above. Now move four of the matches and rearrange them so that the resulting group will be three squares of the original size. No matches may be either added to or taken away from the original number.

How to Hold Your Liquor

2 Arrange three two-inch wineglasses in a triangle, separated by approximately the diameter of the rims. With three matches, make a support between the glass edges that will hold a similar wineglass, base down.

This Represents Real Power

5 Here is deep stuff concerning the motive power of the Earth and the composition of matches. Arrange 15 as shown below.



HERE is fun for the individual or for group amusement. The five tricks shown on this page offer a challenge to puzzle experts, and since kitchen matches are readily available everywhere, the materials are no problem. The teasers are used through the courtesy of Harper & Brothers, publishers of "Puzzles for Everyone," by Julien J. Proskauer. Answers are on page 246.

Two Diamonds from One

3 Arrange six matches on a table as in the figure illustrated below. The problem is to form two diamonds by changing the position of only two matches and adding another one, thus using seven matches in all.

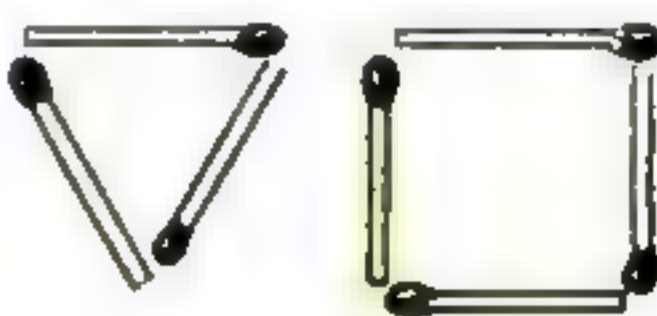


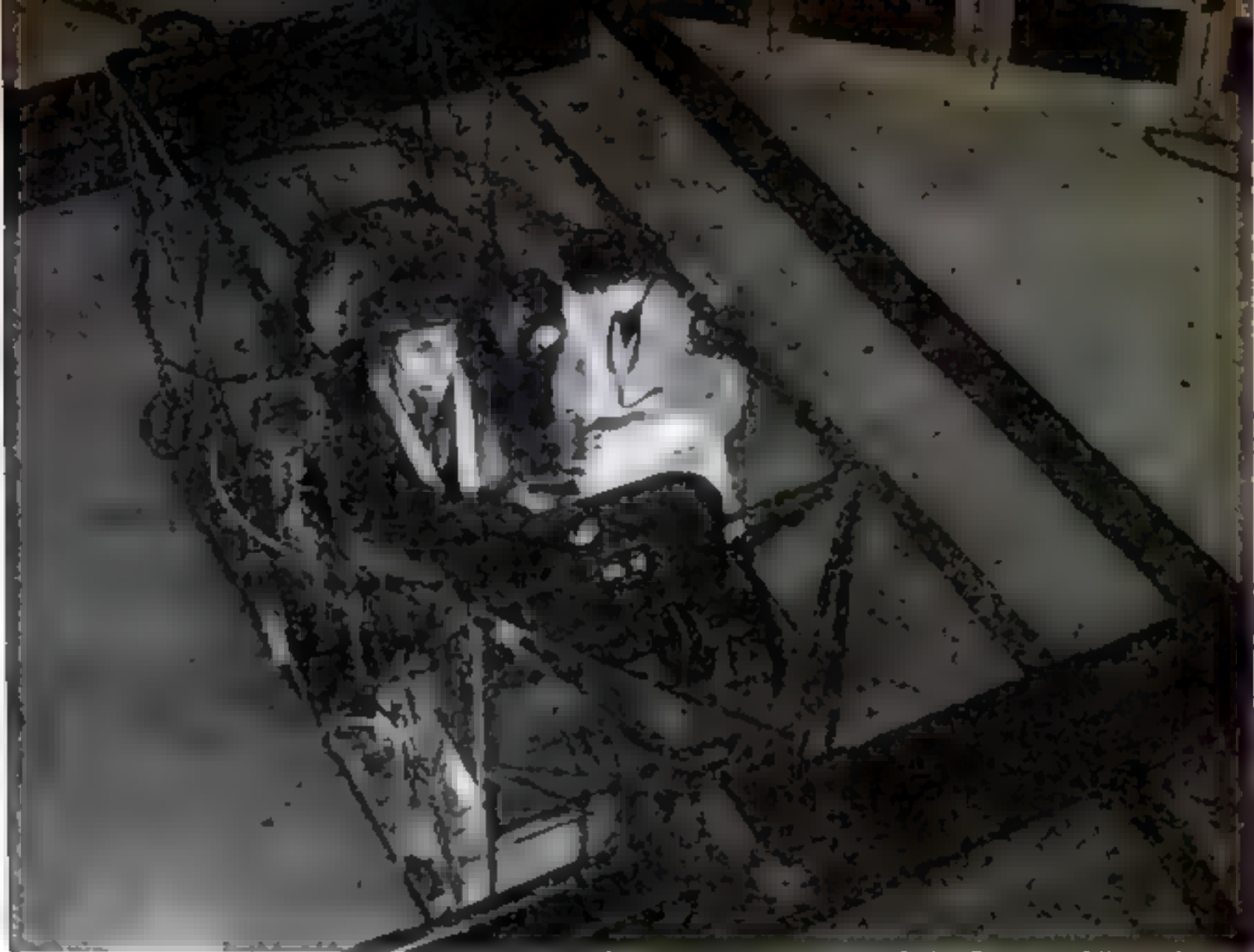
Making a Coin Vanish

4 A wooden match is bent at an angle, placed as shown on the mouth of a bottle, and a dime is laid on top. The problem is to get the dime into the bottle without touching any part of the setup. You'll need to practice this trick to do it well.



Then take away three matches and change the position of one. The result will show what matches are made of





Ready for a whirl in the Wright Field centrifuge, a subject has his pulse taken. The machine tests a man's reactions to centrifugal force in flight

How Many G's Can a Flyer Take?

AT THE Army Air Forces Materiel Command's aeromedical laboratories, Wright Field, Dayton, Ohio, doctors have developed an ingenious device to find out what happens to a pilot when he lays his plane on its side for a tight turn at high speed or pulls out of a hard dive.

When an airplane changes direction, its pilot is subjected to centrifugal force. The degree of that force depends on the speed of the plane and the abruptness of the change. For many years, pilots and doctors alike knew that strange things happened to a man subjected to centrifugal force. What they didn't know was whether those things were serious.

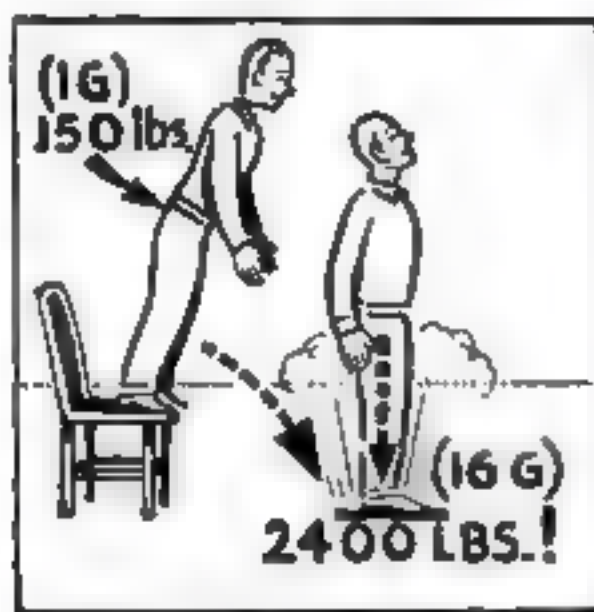
That led to the development of a new kind of centrifuge for use in discovering the effects of this centrifugal force on airmen with accuracy. It is wholly an experimental machine, and is not, as yet, being used to determine service pilots' tolerance to

Wright Field's human centrifuge shows what happens when a pilot loops, dives, and turns at high speed in combat maneuvering.

the centrifugal forces produced in flight.

The centrifuge is exactly what its name denotes. It works on the same principle as a cream separator. It sets up centrifugal forces—the same ones a person gets in an amusement-park roller coaster. It is centrifugal force that keeps the water from spilling from a bucket when you whirl it around your head. A bicyclist "banks" his turn to compensate for centrifugal force.

While the results of less than 18 months' study are secret, it can be disclosed that repeated exposures of a man to powerful cen-



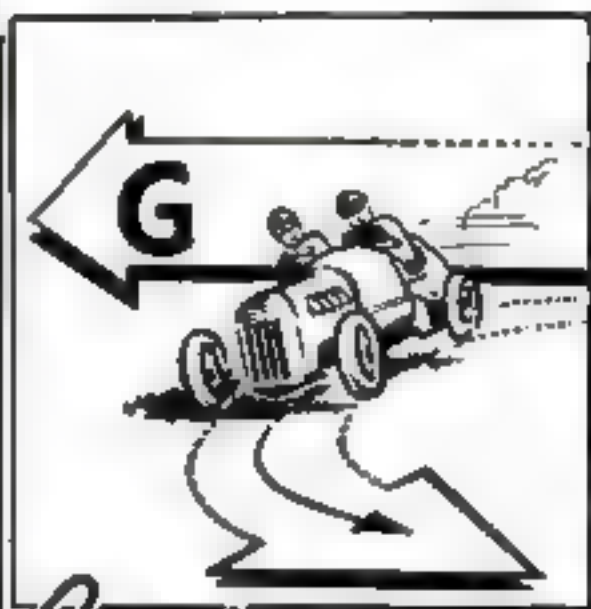
DECELERATION

This man, jumping from an 18-inch chair and landing stiff-legged, would experience a 16-G pull at point of deceleration. G force is "positive" when its direction is from head to foot



ACCELERATION

In this elevator, rising at an increasing speed, G again comes into play, for, as at left, the man's inertia is being overcome. Force is again positive. Negative force is foot to head



Radial ACCELERATION

In making a turn, this fast racing car has had to overcome its natural desire to continue straight on. The resulting G pull, caused by centrifugal force, depends on the speed of the car and sharpness of the turn

trifugal force—or, as the Army puts it, to high G's—have not had harmful effects up to now. "Blacking out" from G's, which means a loss of vision but not of consciousness, makes a person infinitely tired. He feels as though he has gone two or three days without sleep. But a night's rest will bring him back to normal.

A "G" is a unit of measure of pull in any direction. The normal weight of an object is taken as 1 G. The force of gravity is used to measure centrifugal force at the Wright Field laboratory simply because it is a known quantity. Gravity has nothing to do with the strains on the body set up by the centrifuge. The rate at which a body will accelerate in a free fall in a vacuum regardless of its mass or density is 32.2 feet per second per second. The doctors use that as a departure point in their studies.

If centrifugal force makes a 150-pound man exert a pressure of 300 pounds, it will subject him to a pull of 2 G's. "Positive" G's mean a centrifugal force directed from his head toward his feet. A pilot gets positive G's in pulling out of a dive. "Negative" G's pull in the opposite direction, from the feet toward the head. A pilot gets negative G's in an outside loop. If the pull is hard enough he "reds out" as the blood rushes to his head. No experiments in negative G's have been made with the Wright Field centrifuge.

The doctors have discovered that the average man does not black out until he reaches four or five G's. Only two of the subjects tested were able to take seven G's before blacking out. The progressive effects of G pull on a man are:

The hands begin getting heavy and the jowls pull down.

Peripheral vision begins to dim.

Vision disappears but consciousness remains. (Blackout.)

Hearing disappears and thinking becomes confused.

Complete unconsciousness occurs.

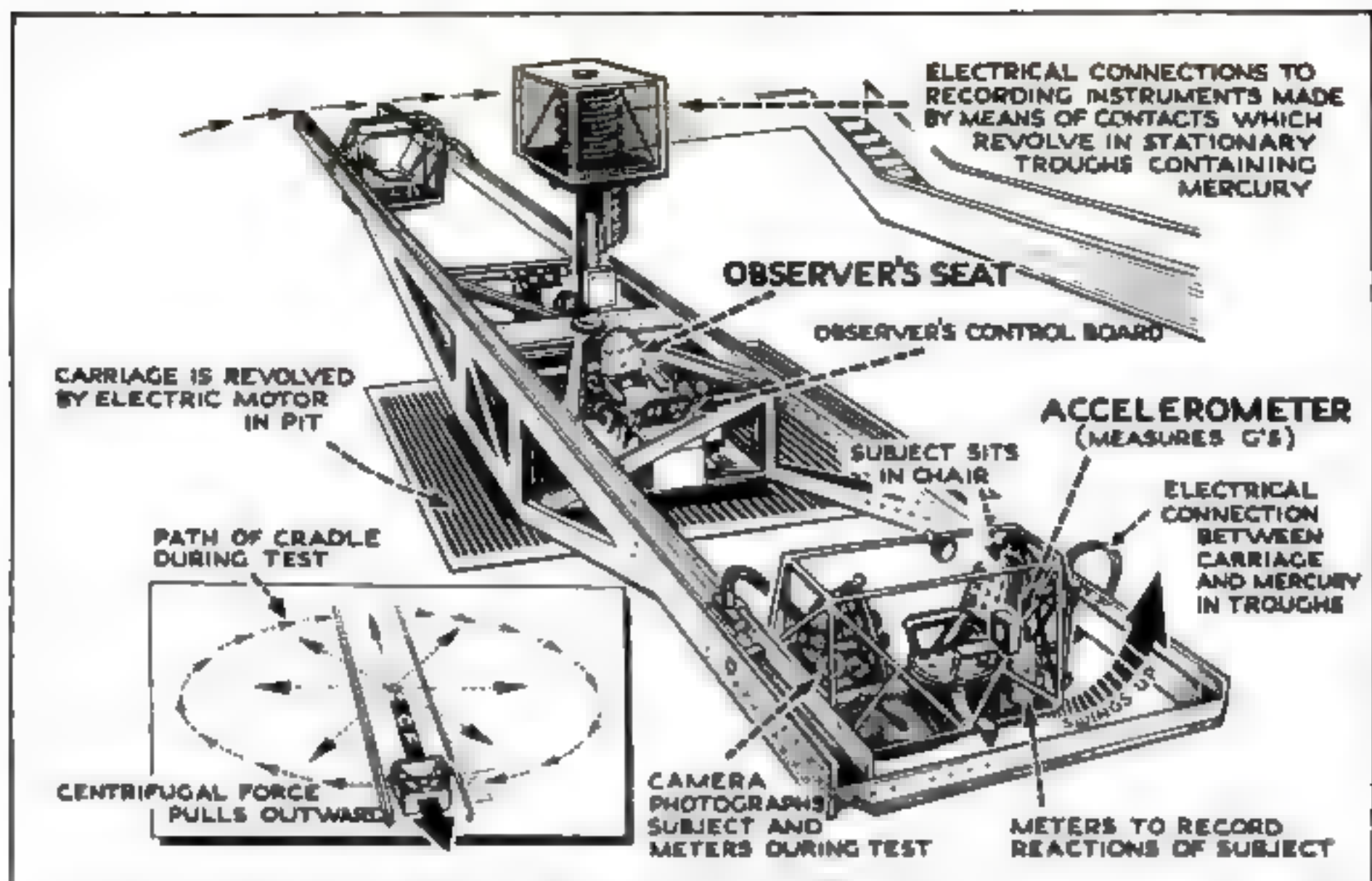
The time element in evaluating G's is important because at low G's it may take eight seconds before blackout sets in. At high or accelerated values, blackout can occur in as short a time as three seconds.

The specialists know now that some tricks of veteran pilots, such as yelling or straining at the moment of pull-out, do have merit in increasing the tolerance to G's. Most of these tricks raise the blood pressure. In-

POSITIVE AND NEGATIVE



Drawings by ERIC SLOANE

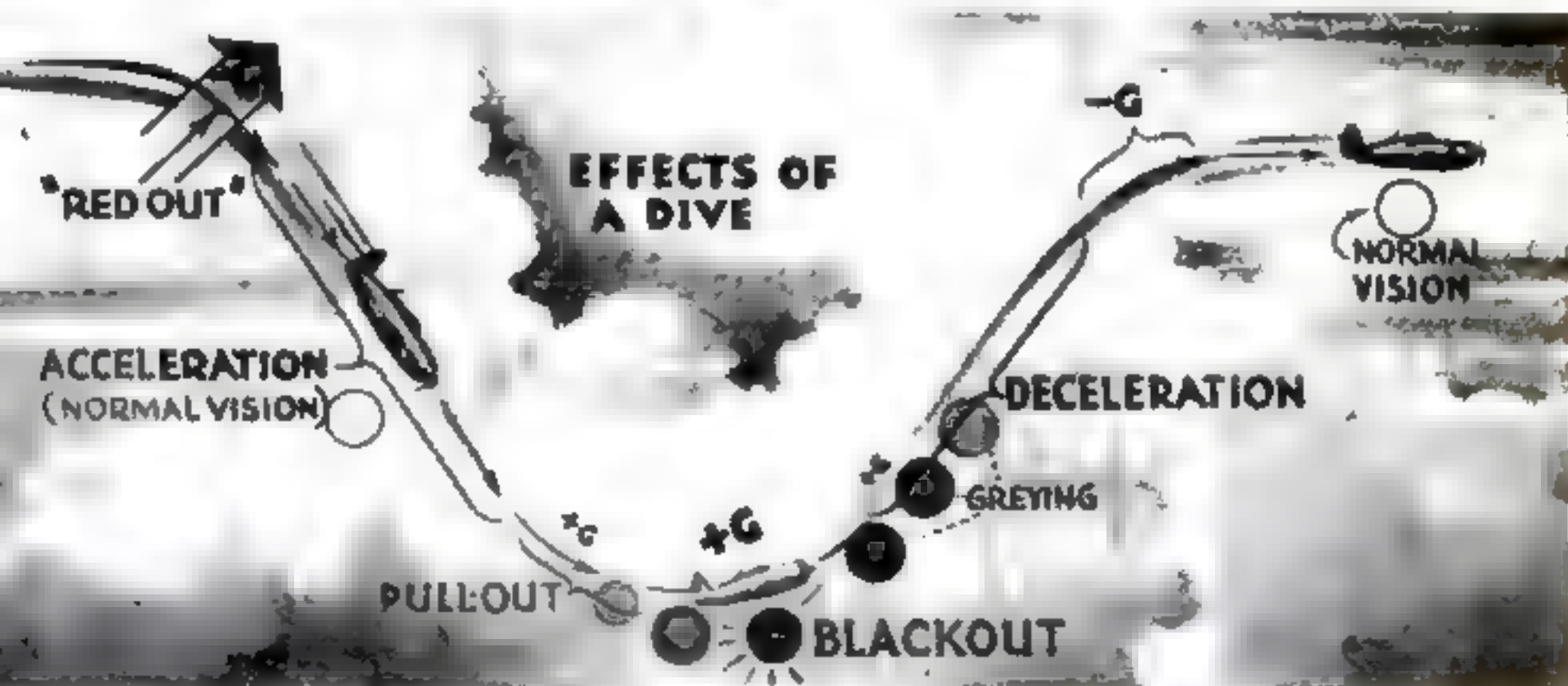


Details of the centrifugal tester. From the seat near the axis of the "marry-go-round," the observer causes lights to flash on the panel of the gondola, and a buzzer to buzz. The subject's quickness in turning them off shows how he is standing the G's. A speed of 35 1/2 r.p.m. usually produces a blackout

creased blood pressure slows the drainage of the blood from the head. A tense pilot will not black out as quickly as a relaxed pilot. That is substantiated by reports from combat and test crews. Back-seat pilots or crew members, not aware that a change of direction is impending, black out. The pilot of the plane, who knows what is coming and braces himself for it, does not.

The centrifuge was designed in 1942 by Capt. Harry W. Jobs of the Air Corps. It was modified by Capt. William Cade. A consultant on the design and operation was Dr. E. J. Baldes of the Mayo Clinic, Rochester, Minn. The centrifuge and acceleration studies are under the direction of Capt. C. A. Maaske, George L. Maison, and George A. Hallenbeck.—DEVON FRANCIS.

G'S—AND WHAT THEY DO TO FAST-FLYING PILOTS





Push-Over Bridges Built Like Magic from Interlocking Parts

By **GOLD V. SANDERS**

Photographs by **WILLIAM W. MORRIS**

PICTURE a steel bridge built entirely on one bank of a stream and then pushed across, supporting itself without any underpinning, and you have a mental image of the Bailey bridge, one of the most ingenious devices born of war's necessity. It sounds like an impossibility, but it is a very real fact. The British and American armies have used it countless times since it was invented in 1940, and it has proved the perfect answer to enemy demolitions. For four years its construction has been kept a secret because of its tactical importance.

Small crews of engineer soldiers throw these bridges across streams and gullies in a few hours; short bridges, long ones, heavy

or light, depending upon what is needed. A small number of standard units are repeated over and over for the different sizes. A 40-foot span can be completed by a crew of 37 men in an hour and a quarter. In seven hours a huge structure 180 feet long can be put up by a crew of 148.

Construction is all on the near bank. The whole structure rests on free-turning rollers while being built. Launching from one bank only is accomplished by the simple expedient of keeping more weight on the bank than is extended over the gap at any one time. The front part, or launching nose, is a skeleton affair that goes across the stream first. Stringers and flooring are left out of it, as well as some of the bracing members used in the bridge proper. The sections of bridge proper, which are built after the nose, are

If you noticed a small reproduction of this photo on page 71 of the September issue, you probably wondered how this strange, self-supporting bridge—the so-called Bailey bridge—was put together. It has been one of the best-kept secrets of the war, but we can now show the whole process



Basic unit member of the bridge is a 10-foot truss panel weighing 600 pounds. These form the sides and supporting members. Here a six-man crew is carrying forward the first panel, which will go into the long launching nose as the first step in bridge building



The first panel is placed on one of a pair of rocking rollers set on a wooden pedestal near the edge of the gap. These, and other rollers set farther back, enable the bridge to be rolled out toward the opposite bank as fast as the following sections are added



When two panels have been placed on the rollers, another crew brings up the first crossbeam, or transom. This is a 10-inch-high I beam, slotted and recessed to fit snugly into the corners of the side panels. Such beams act as braces and support the bridge floor

Now the bridge is growing, link by link. Note the upward tilt given the first two panels, which form a part of the launching nose. This takes care of sag as the bridge is pushed across the gap. The launching nose is unfloored, to make it lighter in weight than the rest



Transoms are quickly fastened to the horizontal and upright parts of the trusses by means of clamps. Two men do this, one working on each side. Above, sway braces are hooked diagonally across each bay or section and tightened with turnbuckles to give rigidity

Manpower shoves the bridge forward as it grows. This section has double truss members, which not only give extra strength but also help provide the necessary weight on the land end to keep the protruding part from tipping downward into the stream or gully





This is how the launching nose looks as it inches out over the chasm. In this case, it consists of five skeleton sections. Its weight is supported by the heavier part back of the rollers. Length of launching nose depends on the width of the gap

fully floored and braced, and also may have additional structural members on each side.

The nose sags somewhat as it is pushed across, but this is allowed for in advance by giving the nose sections an upward tilt when they are put together. All that is needed on the far bank is a pair of rollers to receive the nose. This skeleton part is dismantled, section by section, on the far bank as complete sections are added in the rear and pushed forward.

The primary unit member of the Bailey bridge is a welded steel truss panel 10 feet long and five feet, one inch high. These units are joined end to end by inserting steel pins at top and bottom through matching holes. Bolting is reduced to a minimum by substituting fixed lugs, recesses, and dowels for joining the various members. Six men carry each truss panel and hold it in place while others drive the pins. Another crew brings up a 10-inch I beam that fits snugly across the bottom chords of the trusses and is secured by two special clamps. Steel stringers fit into lugs on the I beams without bolting. When the floor planks and curbing are laid, eight bolts to the 10-foot section hold them all in place. Even this small amount of bolting is simplified by using T-head bolts. The nuts are never re-

moved. The T-heads are inserted through slots in the curbing planks and engage with recesses in the stringers by a quarter turn. Two or three turns of the nuts are enough to tighten them. Four more bolts are used to secure a pair of diagonal braces, and that is all the nut-turning there is in a 10-foot section of bridge, unless added rows and tiers of panels are put on for greater strength. Sway braces underneath are hooked on and tightened with turnbuckles.

When there is sufficient space, a whole Bailey bridge, nose and all, is built at once and then pushed across the gap. If working space is limited, a section at a time may be added and pushed forward, just so there is always sufficient weight back of the front rollers to keep the nose from tipping into the stream.

The various versions of the bridge are referred to as single-single, double-single, triple-double, and so on, depending upon the multiple of truss panels added alongside the first pair or in tiers. The I beams or cross members are notched to receive three rows of trusses on each side.

The capacity of all sizes of Bailey bridges is precalculated in accordance with the length of span and multiple of trusses used. Under the urgency of warfare, Bailey bridges 300 feet long have been built. Much wider gaps have been bridged where enemy demolitions left the piers of old bridges standing. With such supports at intervals, Bailey bridges can be stretched to practically any length. They can also be laid on pontons.

The Bailey bridge takes its name from Donald Bailey, a British engineer who conceived it in 1940. It went into use that same year, and was so much better than anything else of the kind that it was adopted as standard by the U.S. Army. Now it is built here, and the component parts made here and in England are all interchangeable. The U.S. Army had a 10-ton bridge, which was also launched from one bank (PSM, May '43, p. 73), but this lacked many of the good features of the Bailey bridge.

A standard Bailey bridge set has sufficient units to build a double-double 150 feet long. To carry this material, 21 2½-ton trucks

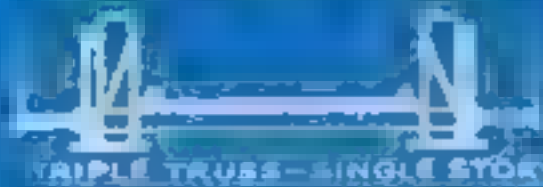
FIVE TYPES OF BRIDGE TO SUIT ANY LOAD OR SPAN



SINGLE TRUSS—SINGLE STORY



DOUBLE TRUSS—SINGLE STORY



TRIPLE TRUSS—SINGLE STORY



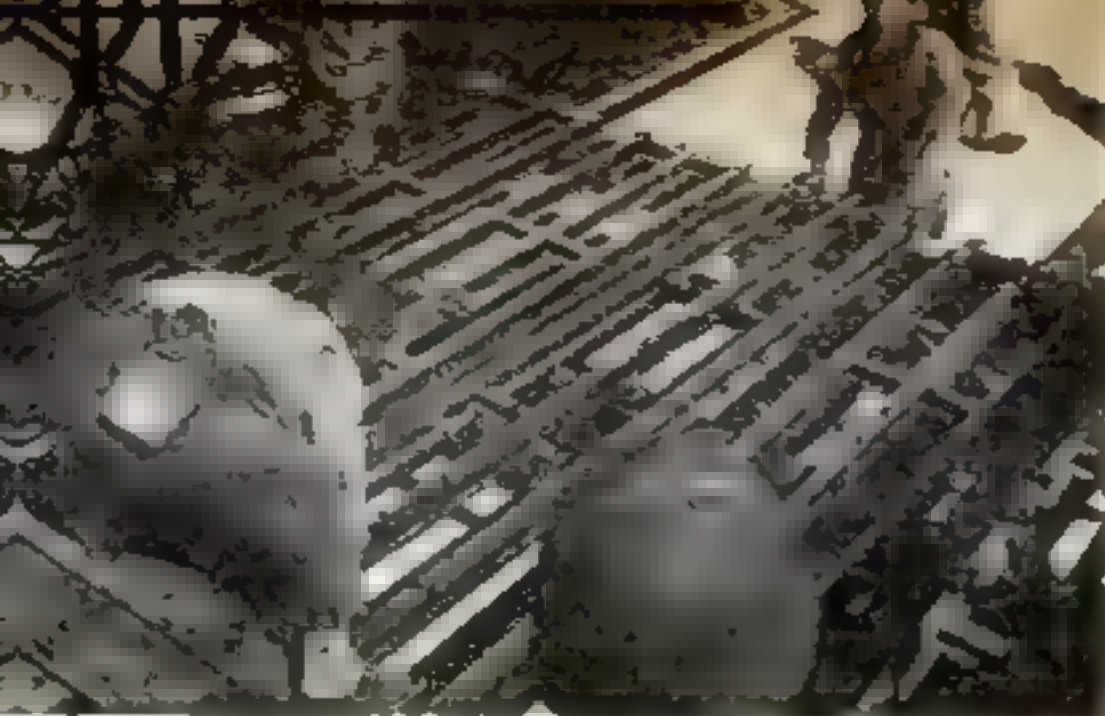
DOUBLE TRUSS—DOUBLE STORY



TRIPLE TRUSS—DOUBLE STORY

ALL END VIEWS

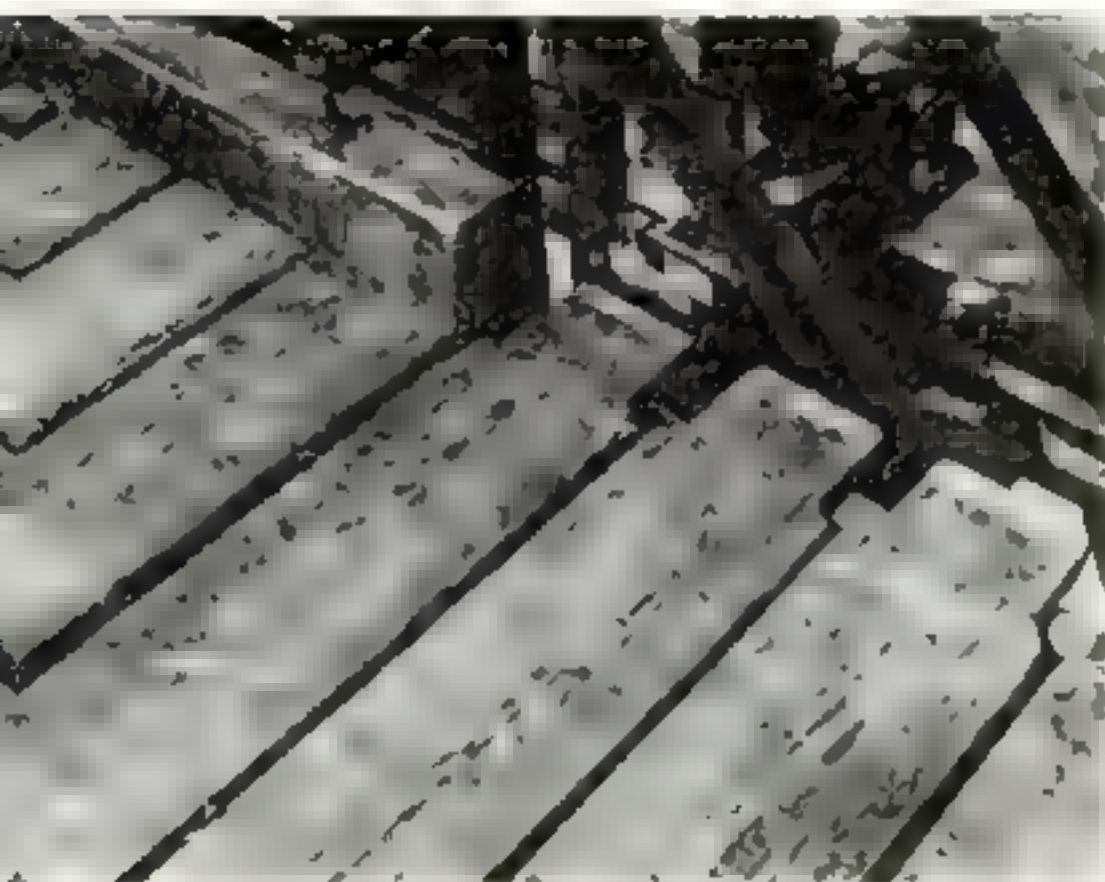
Truss panels added alongside the original pair, or placed in tiers, increase strength. Engineers know exactly what load each type will bear for the various lengths of span.



These men are laying the stringer units, which fit neatly into lugs on the crossbeams and need no bolting. All parts of the Bailey bridge are designed to go together with a minimum of labor and to require the smallest possible number of tools and fittings.



The floor planks, ready cut and notched at the ends, are laid across the steel stringers. A standard set of Bailey bridge parts contains enough materials to build a double-truss, double-story span of 150 feet. Twenty-one 2-ton trucks and trailers carry it all.



This shows how the notched ends of the floor planks fit between the buttons on the outside edges of the stringers. Flooring units are sturdy enough to stand up under the heaviest loads—including heavy tanks.



One curbing plank covers the ends of 13 floor planks. Four bolts, which go through the curb planks and engage with the stringers, hold down the ends of all 13 planks. This completes the flooring of the section.

ATTACHING WALKWAY.

A 2½-foot walkway is installed on each side if needed. Steel supporting members fit into recesses in the crossbeams and need no bolts.

Ten-foot ready-made sections of wooden walkway are laid on the steel supports. The walkways are handy when there is a good deal of foot traffic, or when infantrymen and vehicles cross simultaneously.

Guard rail stanchions slip into the holes at the ends of the steel walkway supports. Rope is strung through split rings in the stanchions, forming guard rails that keep crowded troops from being jostled over the edge of the walkway into the stream.

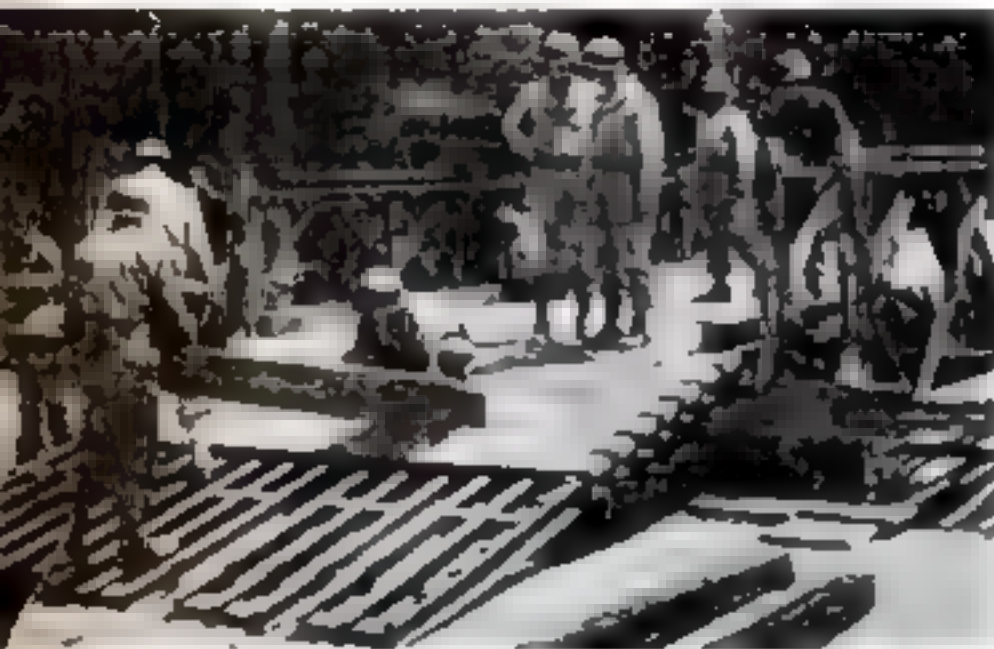




On the far bank, another pair of rollers has been set up and a part of the crew is ready to receive the launching nose as it inches over. Standing on the nose, the officer in charge directs the ticklish job



The bridge now rests on rollers at both ends. As the additional sections are added on the opposite side, it is pushed over and the launching nose is taken off, part by part. A bulldozer often helps with the pushing



When the floored portion of the bridge gets across, prefabricated ramp stringer units are quickly laid to form the approach. Floor planks and curbing are laid on the ramp in the same manner as on the bridge



Over the finished bridge roll a jeep, a scout car, and a medium tank, while infantrymen file across the walkway on one side. This 110-foot, double-truss, single-story job was built by 37 men in a few hours

and trailers are required. Loading is standardized so that each truck and trailer carries one section of bridge plus the few tools needed in erection. If some trucks are knocked out, a complete bridge of smaller size may still be built.

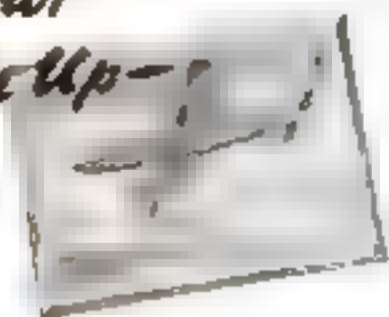
In practice, a Bailey bridge is often built of single or double construction to carry light loads at first, then strengthened later by adding more trusses so that it can bear the heaviest equipment. In this way, the bridge first serves light combat units and then, as the battle line advances, carries the heavier traffic of supply and reinforcement. These bridges can be disassembled

as easily as they are erected, but in some instances they have become virtually permanent spans.

It takes more than the demolition of bridges to stop an army equipped with this ingenious device. The Bailey bridge offers one more example of the way in which clever design, mass-production manufacture, and superb tactical application in the field have changed the art of war. In Italy and in France it robbed the retreating enemy of one of his few remaining defenses and kept him from trading dynamite for precious time in which to withdraw and reform his lines.

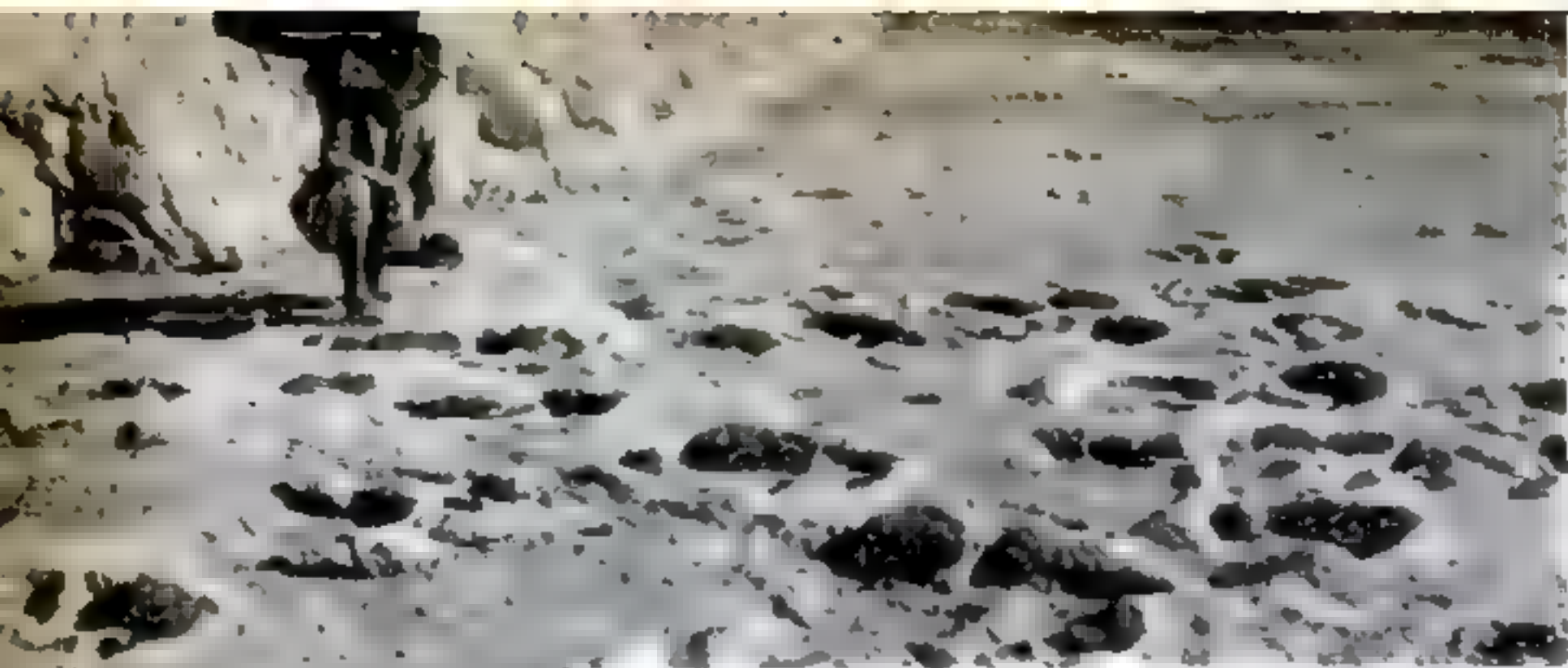
C-69 CONSTELLATION TRANSPORT

Your
Pin Up—



Carrying key personnel and critical equipment to war fronts is the important job of the Lockheed C-69 Constellation, pictured here by Jo Katula. This big four-motored transport can carry 55 passengers (in addition to its crew of nine) or 15 tons of cargo. Some idea of its speed and range is given by the fact that one of these ships flew nonstop from Los Angeles to Washington in less than seven hours

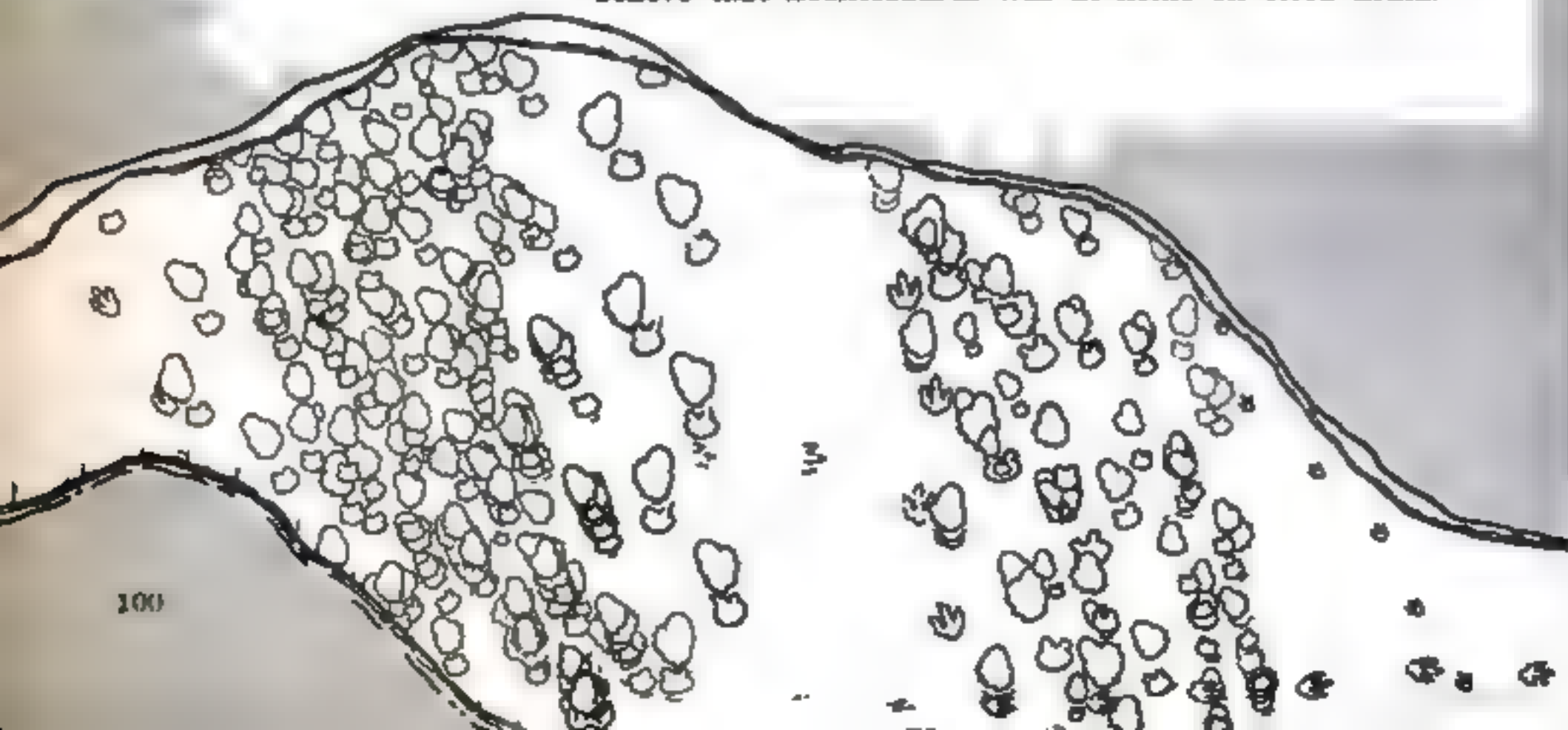




Could the Brontosaurus Walk on Land ?

These titanic footprints, made in mud that later hardened into rock, were left by seven monstrous sauropod dinosaurs that passed this way some 120 million years ago. To reach these markings, a number of sediment layers, which undoubtedly aided in preserving the tracks through the ages, first had to be removed. The absence of trailing marks indicates that at the time of the dinosaurs' passing the area was covered with water deep enough to float the reptiles' tails off the muddy bottom, as pictured in the sketch at right

DINOSAUR footprints found in Bandera County, Texas, offer a clue to a mystery that has long baffled paleontologists: Could the prehistoric Brontosaurus walk on land? This 27-ton sauropod, largest reptile ever to inhabit the earth, was known to have been a good swimmer; but could his legs support his great weight? The 120,000-000-year-old tracks shown on these pages lead experts to believe that Brontosaurus was at home on terra firma.





Sun cracks in the silt that partially filled these dinosaur tracks suggest that the area was sometimes completely above water. Although undeniably tremendous, the size of these footprints is not astonishing when it is remembered that they were made by mammoth reptiles that grew to a length of 70 feet and often weighed 30 tons. The chart at left, of the dinosaurs' "stamping ground," shows markings left by 23 of these monsters. Included are footprints of the three-toed carnivorous dinosaur, a considerably smaller and distinctly different reptile from the gigantic herbivorous sauropod



How SHIPS TALK WITH FLAGS

By JAMES W. LEES, JR.

WHEN a war fleet or convoy enters a zone of "radio silence," many-hued flags enable ships to talk to each other without revealing their position to an enemy. A colorful heritage from long before the dawn of wireless, flag signals still find plenty of peacetime use, too. Within range of clear visibility, their messages cannot be garbled, and mean the same thing to a Norwegian or French or American sea captain.

How flag signals work is illustrated by the International Signal Code, which employs the 40 symbols pictured below. A display of these on a single halyard constitutes a "hoist" and is read from top to bottom. Each letter of the alphabet has a distinctive flag; and each numeral, a pennant. Three "repeaters" enable letters or numbers to be duplicated, so that a single set of flags suffices to transmit "pass," "noon," or "2222." All merchant vessels communicate with each other and with warcraft by the International Code. When a man-of-war

The International Signal Code, translatable in seven languages, is invaluable to fighting and cargo ships operating in zones of "radio silence." Messages are sent in one, two, three, or four-letter groups, those

in smaller groups being the most common or urgent. For instance, "O" means "Man overboard." "OL" commands "Heave to or I will open fire on you." "VZ10" (in "hoist" at far right) means "Increase your

THE 40 FLAGS AND PENNANTS OF THE INTERNATIONAL



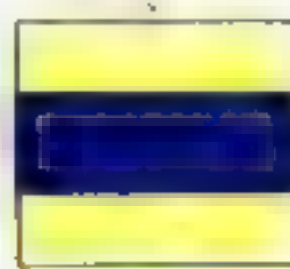
Afirm



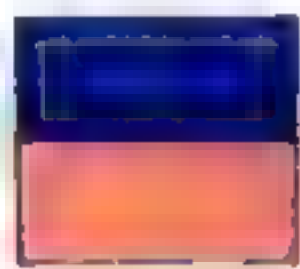
Baker



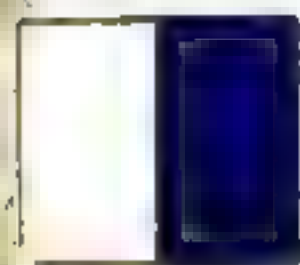
Charlie



Dog



Easy



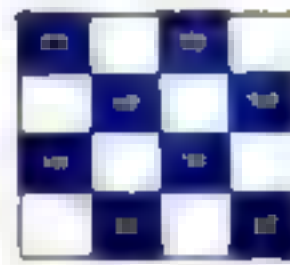
King



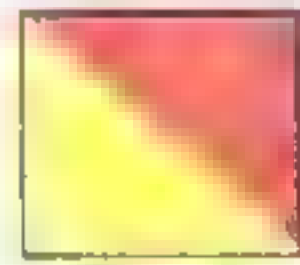
Love



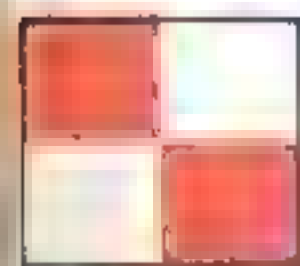
Mike



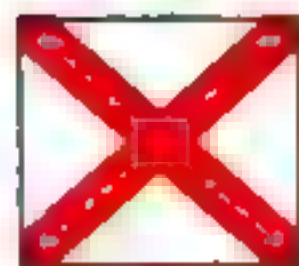
Negat



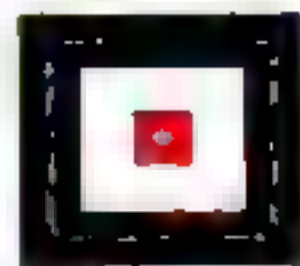
Option



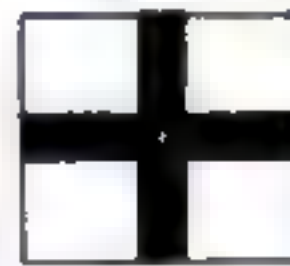
Uncle



Victor



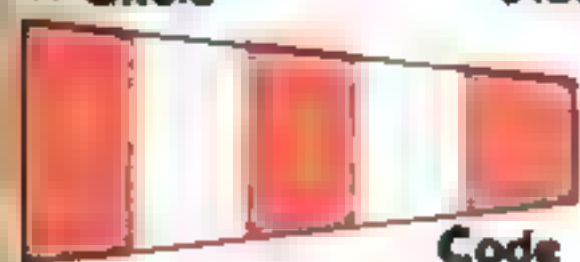
William



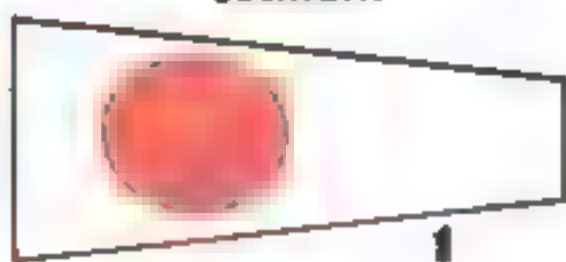
Xray



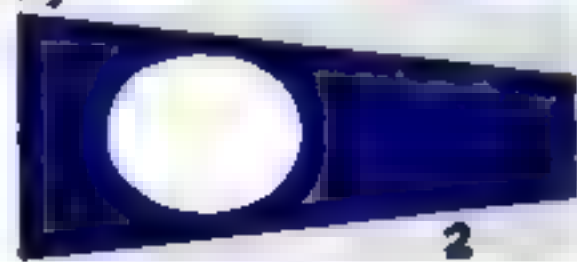
Yoke



Code



1



2



6

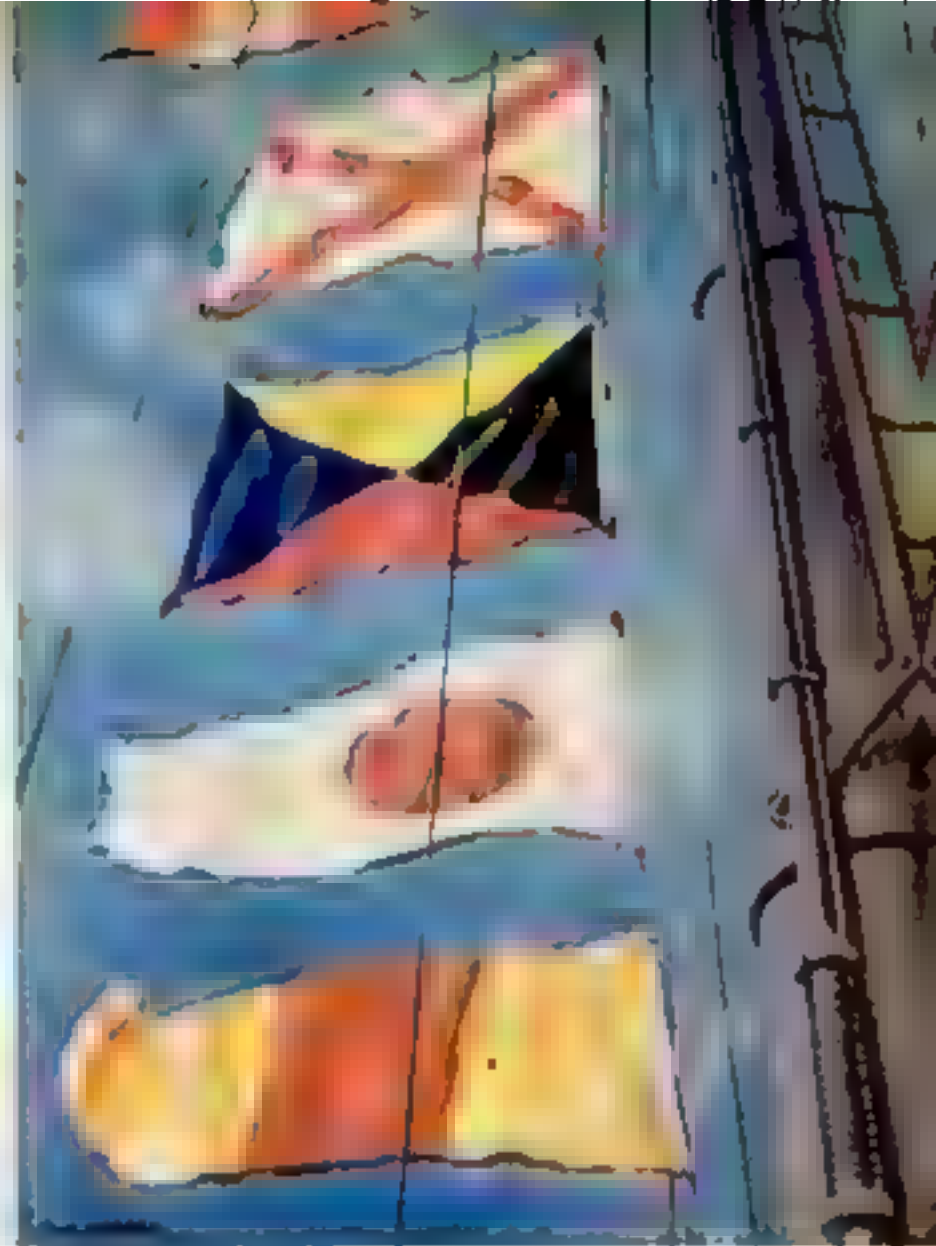


7

wishes to address a merchantman, it hoists the code pennant.

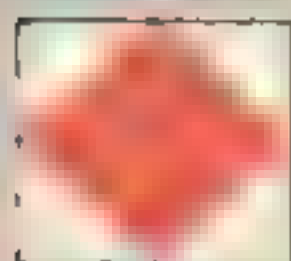
Simplest, but slowest, of signaling methods would be to spell out each message, letter by letter. In practice, only personal names and addressees need be transmitted this way. Thousands of "code groups," or arbitrary combinations of letters, internationally agreed upon and conveniently listed in all mariners' code books, provide a shorthand equivalent for practically every word or sentence in the language of the sea.

One-letter flag displays serve for the most common or urgent messages—*C* for "Yea," *N* for "No," *O* for "Man overboard." Two-letter code groups follow in priority. *OL* commands "Heave to or I will open fire on you." *RP* warns "You should keep a lookout for mines." Three-letter hoists provide the main vocabulary of flag signals; thus, *IGH*, "Did you get latitude at noon?" and *OGF*, "Storm track is curving to right." Four-letter combinations, if they start with *A*,

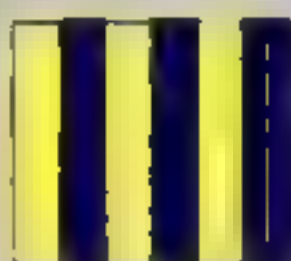


speed to 10 knots." Messages may also be sent by secret code, or by spelling out each word, in which case the "code" pennant is not included in the hoist. Names (shown under symbols) are used to prevent confusion in referring to flags

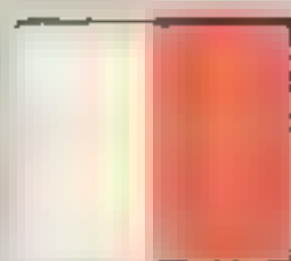
SIGNAL CODE — THE "SIGN LANGUAGE" OF THE SEA



Fox



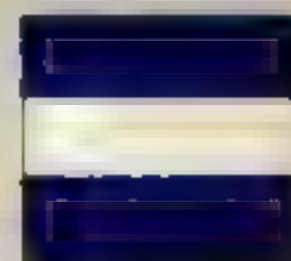
George



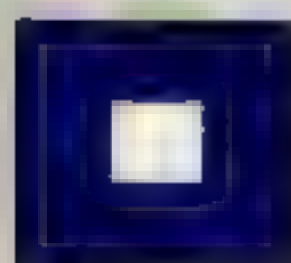
How



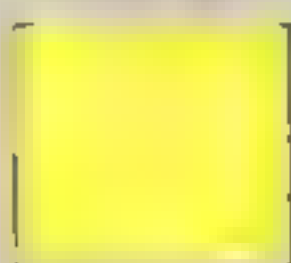
Int



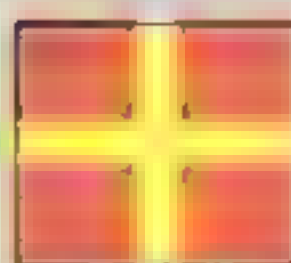
Jig



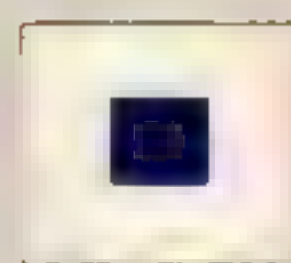
Prep



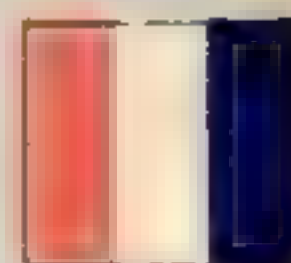
Queen



Roger



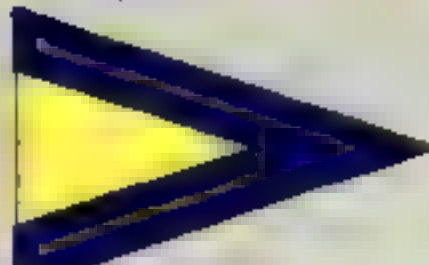
Sugar



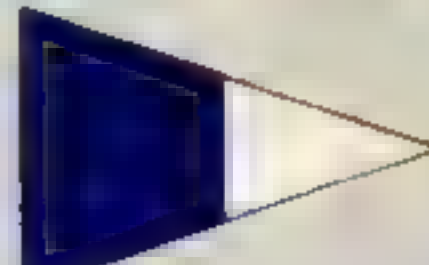
Tare



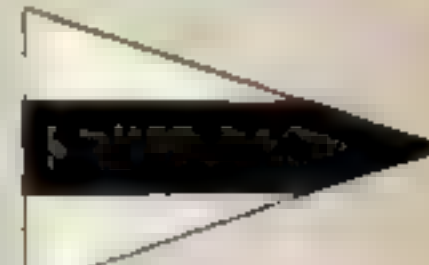
Zebra



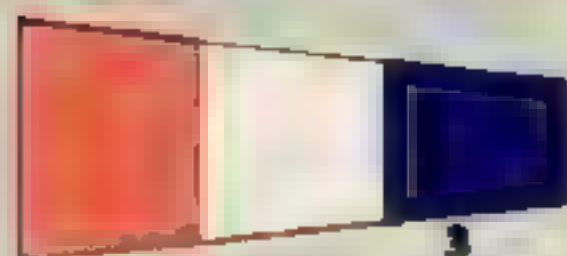
1st Repeat



2nd Repeat



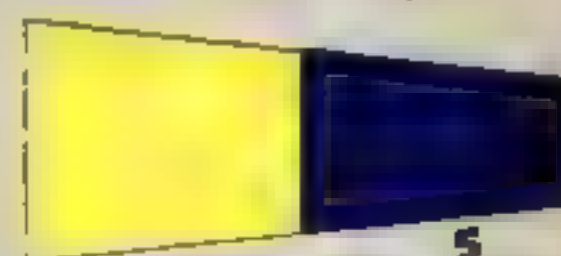
3rd Repeat



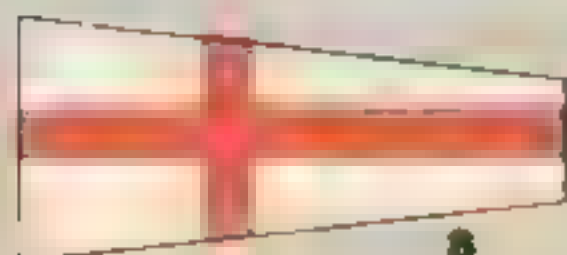
3



4



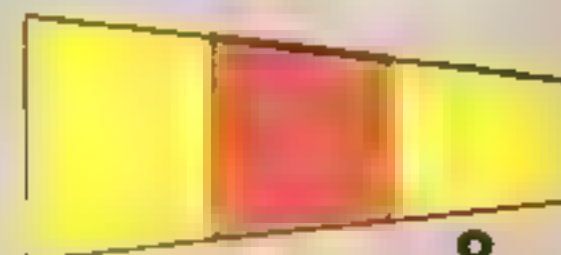
5



6



9



0



Of all the many flags that warships have occasion to break out from time to time, the only one to top Old Glory is the Church pennant. It is flown, however, only when religious services are being held on board.



Here a crew member rigs up a special colored lamp on a convoyed merchantman. Lamps of various colors are used by our warships and cargo vessels for communicating with each other at night by code.

are place names—*AMOX* for Pearl Harbor, *ABQQ* for Berlin, *AQGA* for Tokyo. Identifying flag signals for ships, displayed in peacetime when entering port, are the same as their radio call letters. The first letter designates the nationality of the vessel—for example, *K*, *N*, or *W* stands for the United States.

To avoid mistranslations of the flags, signals keep the decoder informed whether

a hoist is in code or spelled out; and a "tack line," or six-foot length of halyard, sets apart one code group or word from the next.

Naval vessels of all sea powers talk among themselves by secret flag codes, devised for their specialized needs. In time of war, allies such as the United States and Great Britain exchange their warship codes, and use one or the other, by prearrangement, in joint naval operations.

Official U. S. Navy photographs

On gala occasions, a U. S. warship will make a "full-dress" display by breaking out every flag on board, including those of the secret Warship Code, stringing them up from bow to stern in a prescribed order.





The fourth flag down on this hoist is strictly non-GI. Carrying such markings as an exclamation point and question mark, it is a "what-the-hell" flag, flown by a Yank skipper in jownty defiance of enemy action

Semaphore code, employing two small hand flags of like pattern and colors, transmits messages rapidly at close range. Letters of the alphabet are indicated by the positions in which the flags are held, and all words and numbers are spelled out.

Special flags denote the presence aboard ship of the President, the Secretary of State, and other high officials.

Even the Stars and Stripes may serve as a signal flag. Recently enacted law preserves the time-honored usage of flying it upside down "as a signal of dire distress."

On gala occasions, a rainbow of signal flags bridges the masts and extends to the bow and stern of a vessel. Does the arrangement follow any particular order? In the Navy, originally, no. But long ago, tradition has it, a plainly readable and uncomplimentary message worked into the display by a practical joker reddened the face of his skipper. From that day to this, Navy regulations strictly prescribe an exact sequence of flags, so carefully chosen that it means absolutely nothing in plain language, code, or Sanskrit.

After dark, when signal flags cannot be distinguished, flashing lights provide visual communication in war and peace. Convoys also use colored signal lamps in a special code of their own.



Comes dusk and a ship turns to its signaling light, which can be made to blink out fast dot-and-dash messages by flicking the shutters in front of the lens. Man in foreground is reading an incoming message

The flag "bag" on the signal bridge of a U. S. battlewagon. Because of the "repeat" flags shown on page 103, only one flag need be carried for each symbol

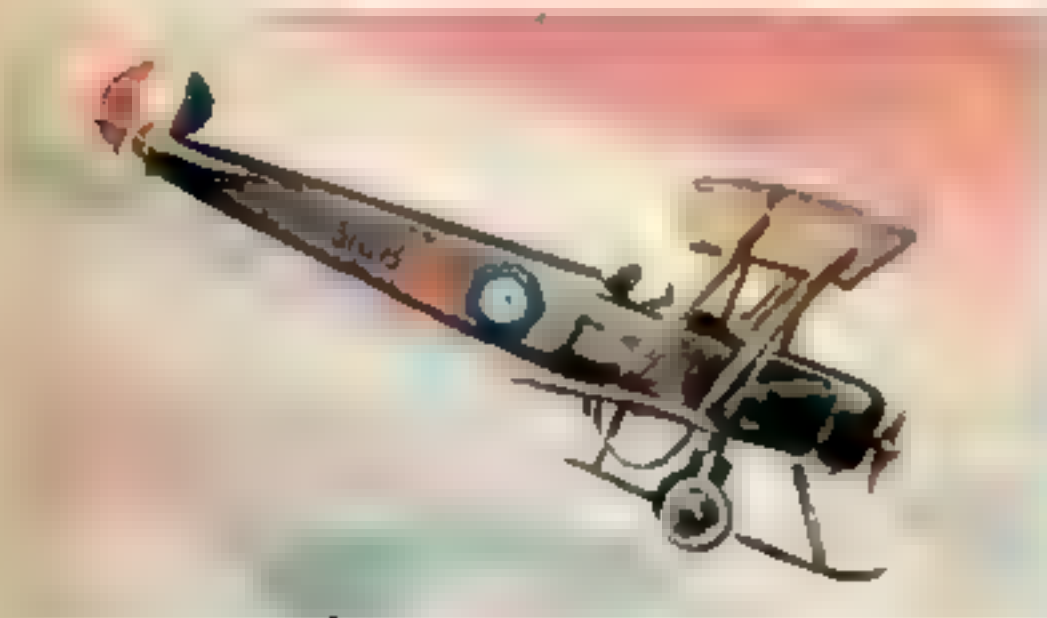




1909 Early successful Avros were small, flimsy triplanes. This had a motorcycle engine and a four-bladed propeller



1912 Three years later, this test cabin monoplane was powered by a radial engine and had new wing mounting



1914 The Avro 504-K was equipped with an 80 or 100-hp. rotary engine. It was a standard trainer for nearly a decade

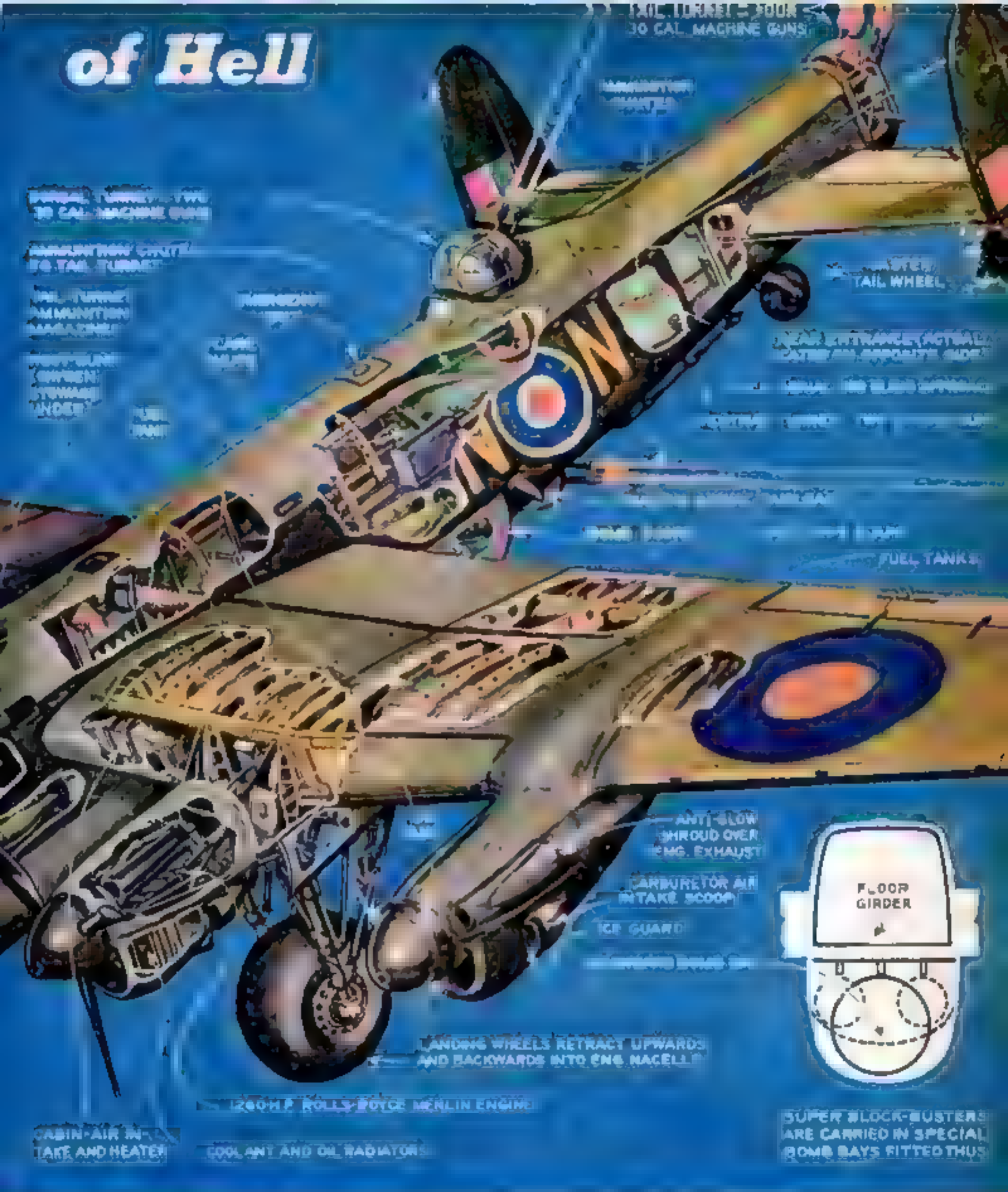


1916 First Avro twin-engine heavy bombers were the Pike and Manchester, forerunners of the Lancaster shown right



BACKBONE of the hard-hitting British Bomber Command is the Avro Lancaster, the great ship that has been dumping truck loads of hell on Berlin and other Nazi points with pleasing regularity. Her eight-ton bomb capacity includes accommodations for "cookies"—British term for blockbusters—and a variety of incendiary bombs, and she packs 10 medium-caliber machine guns in her four power-operated turrets for shooting off interference by German fighter

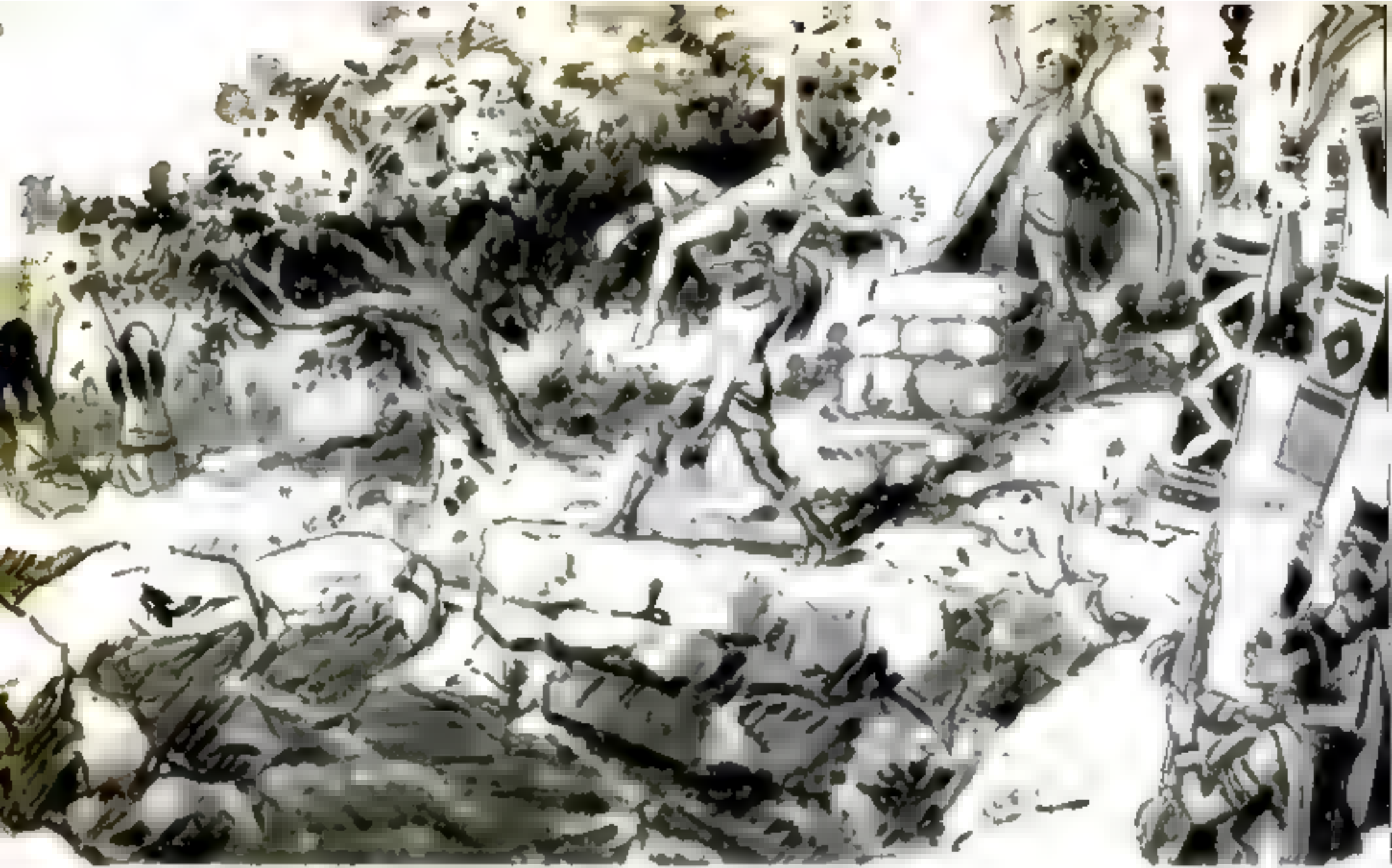
of Hell



planes. Behind the Lancaster design lie nearly 40 years of successful airplane construction by a distinguished firm. The first Avro plane to leave the ground was a biplane which, in 1906, was the first of all British-built planes to fly. The name Avro is derived from the pioneer builder and pilot responsible for this first plane—A. V. Roe, now Sir Allison V. Roe.

A comparison of the full-color cut-away

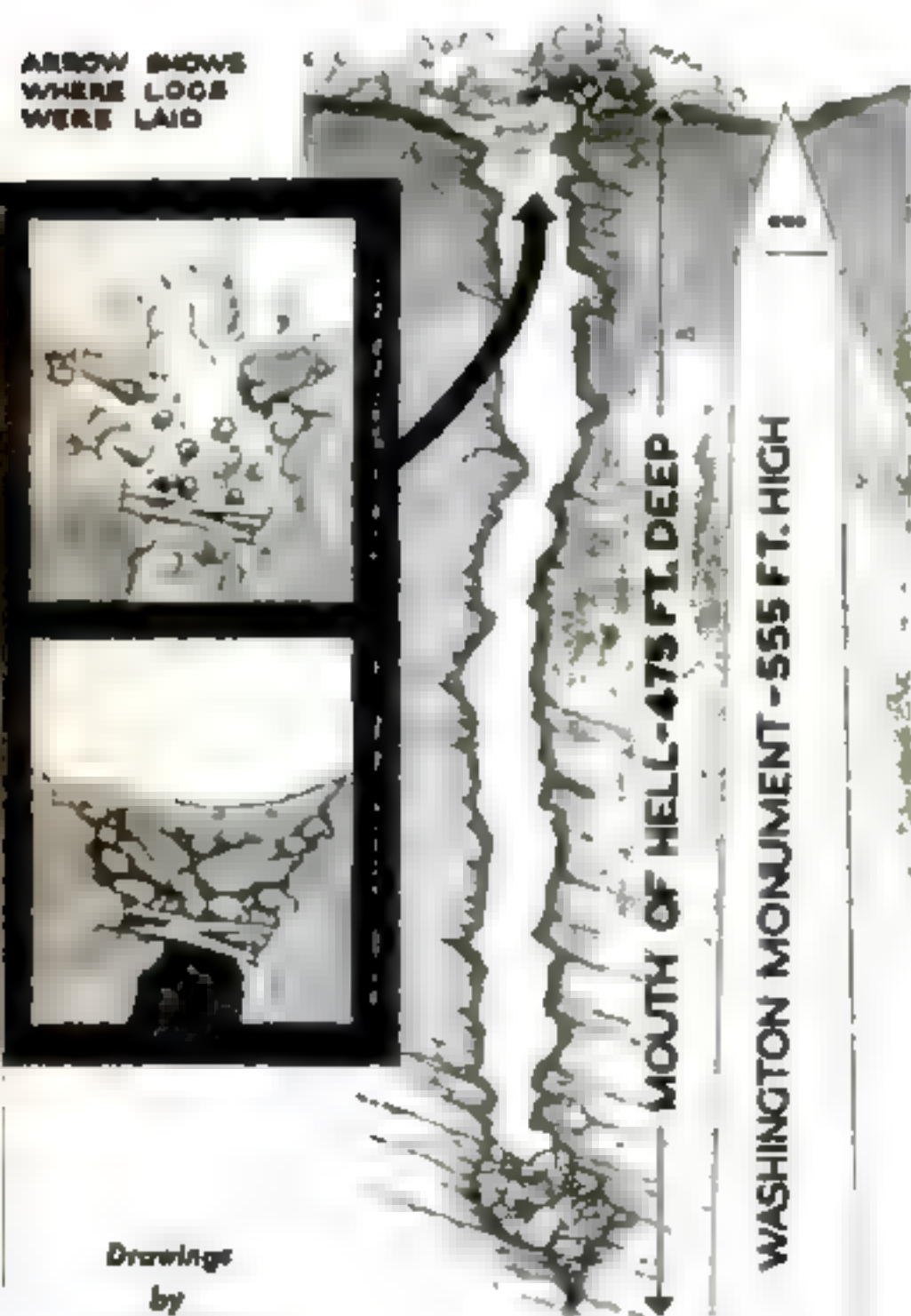
above with the paintings at the left provides an interesting commentary on the rapid development of Avro design between the 9-hp. triplane model dated 1909, and the 5,000-hp. four-motored bomber of the present year. Best known to the flyers of World War I was the versatile model 504-K, in which probably more war flyers were trained than in any other single design of ship, not excepting our own "Jenny"



Scene of innumerable tragedies throughout the centuries, from ancient Aztec religious rites to plain murder and suicide, this Mexican terror pit has been sealed forever by the method illustrated at the left

Shutting Hell's Mouth

SCREAMING sacrifices to strange gods, corpses of medieval victims of persecution, even the grisly results of Chicago gangster activities have hurtled down to oblivion in the gaping earth slit that is called The Mouth of Hell. That's all over now, for the citizens of Taxco, 105 miles south of Mexico City, have, with the help of an American and a Mexican engineer, sealed it up forever. Formerly believed to be a mile deep, the hole has been shown by scientific measurements to go down 475 feet. To remove this relic of barbarism, heavy timbers were braced on jutting rocks a few feet below the orifice; when dynamite charges were set off near the surface, tons of rocks keystoneed across the horror hole, closing it for all time. The operation, which cost about \$500, was undertaken after exhaustive exploration by Dr. Esequiel Ordoñez, leading Mexican geologist, and other scientists.



Drawings
by
R. G. SEIELSTAD



All-Purpose Soap Aids Our GI Joes

MAKING life a lot easier for our soldiers is a soap mild enough for shaving, powerful enough for the greasiest pots and pans, and capable of producing a foamy lather in water hard or soft, fresh or salt, hot or cold. Secret of the soap lies in a synthetic sulpho-nated product developed from petroleum by Du Pont and known merely as MP 646. It is being sold by the hundreds of thousands of pounds to soap manufacturers who add it to their products in the ratio of one to two. Wide civilian use is expected in postwar years.

K. P. LOSES much of its terror because of the new soap's exceptional ability to chase dirt, oil, and grease in any kind of water. Postwar use of the soap is expected to be extensive



Mild enough for toilet use, and yet powerful enough to clean the grubbiest clothes, the new soap produces a lather in either sea water or water that is hard and cold

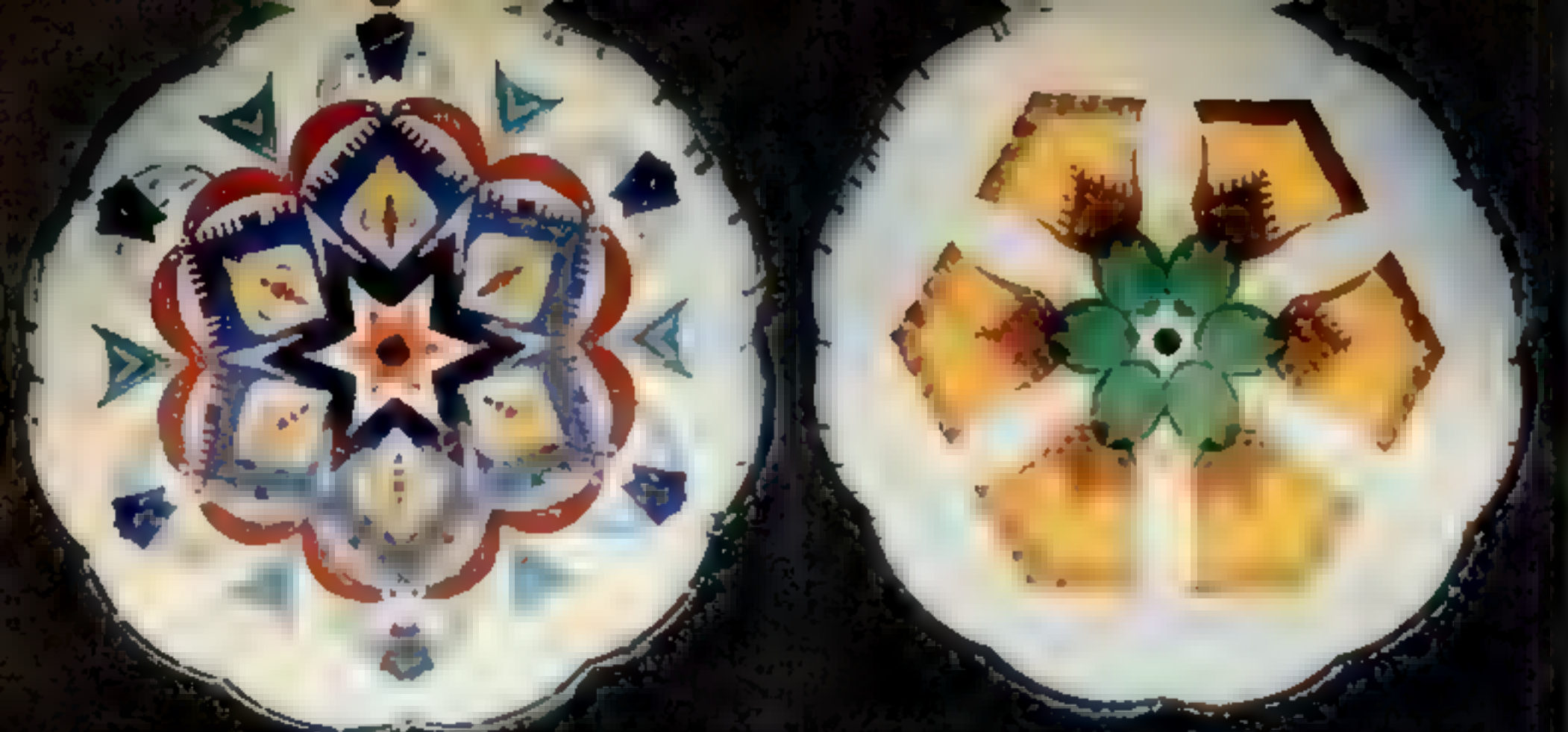
SHAVING, with the new soap, is made immeasurably easier for the soldier, who never knows what kind of water he may find at hand. Chief ingredient, which is added to other constituents of the soap in a proportion of one to two, is a synthetic sulpho-nated product developed from petroleum by Du Pont and known as MP 646. It is now being sold in quantity to manufacturers

A SIMPLE TEST



Hard water usually contains magnesium or calcium, which changes places with the sodium or potassium of ordinary soap to produce an insoluble compound, as in glass at the right. Suds in the glass at left were produced with the new soap. When emptied, this glass will easily rinse clean; the other will retain a sticky scum





That beauty is in the eye of the beholder is literally true of these kaleidoscope patterns, for only one twelfth of each is real, a jumble of bits of plastic and glass. Eleven twelfths are reflections, blended by repetition into a symmetrical whole. These designs were photographed in a kaleidoscope built especially for P.S.M. To minimize the loss of light in successive reflections, special mirrors are used. They consist of plate glass on which vaporized aluminum has been deposited in a vacuum to form the reflecting surface. For these photos, the kaleidoscope was illuminated by two 2,000-watt spotlights shining through a sheet of opal glass. One-second exposures were made on Kodachrome film at lens openings of from $f/8$ to $f/16$.

Our Color Camera Takes a Look

By HARRY WALTON

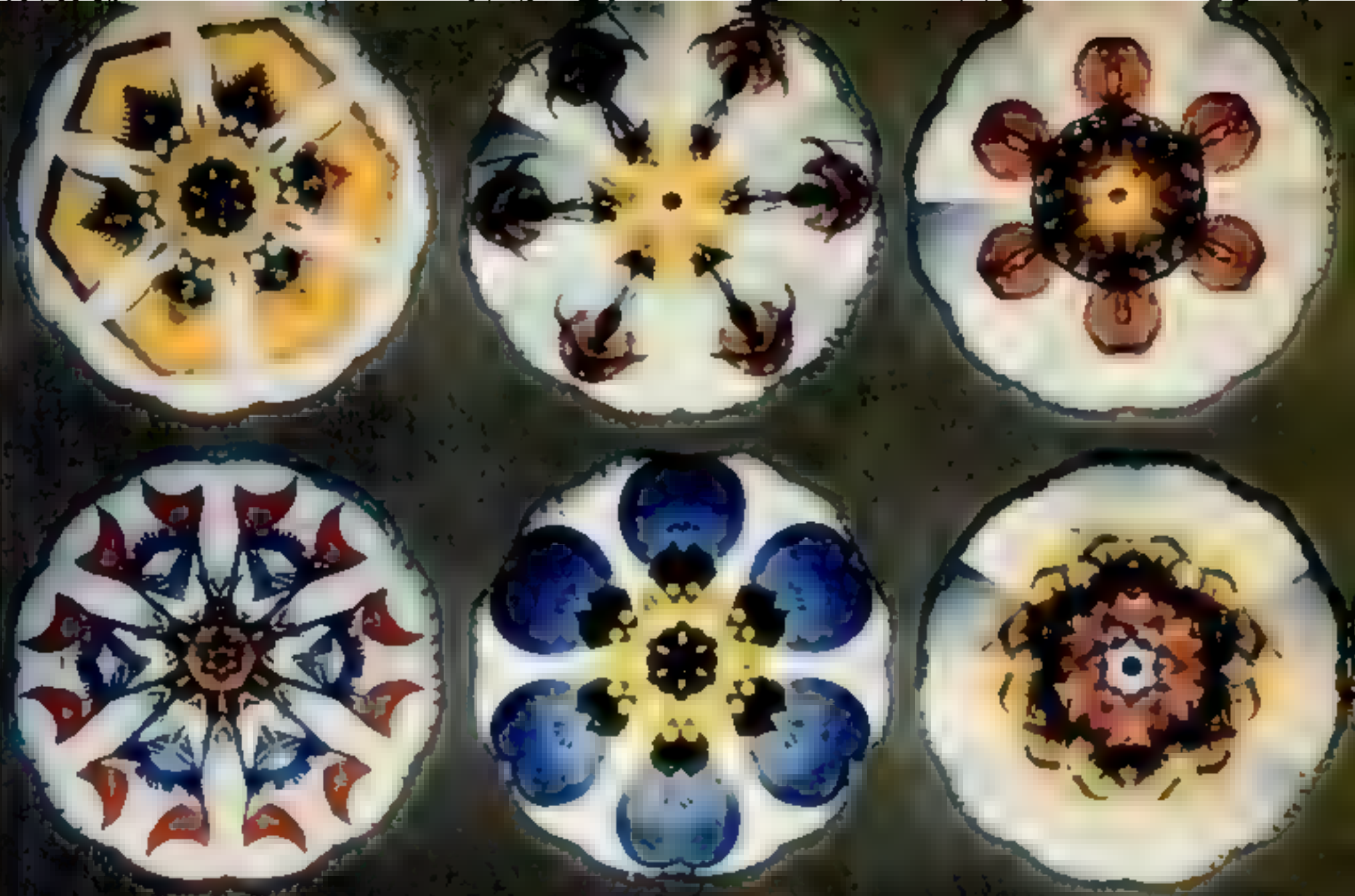
Photographs by WILLIAM MORRIS
and ROBERT SMITH



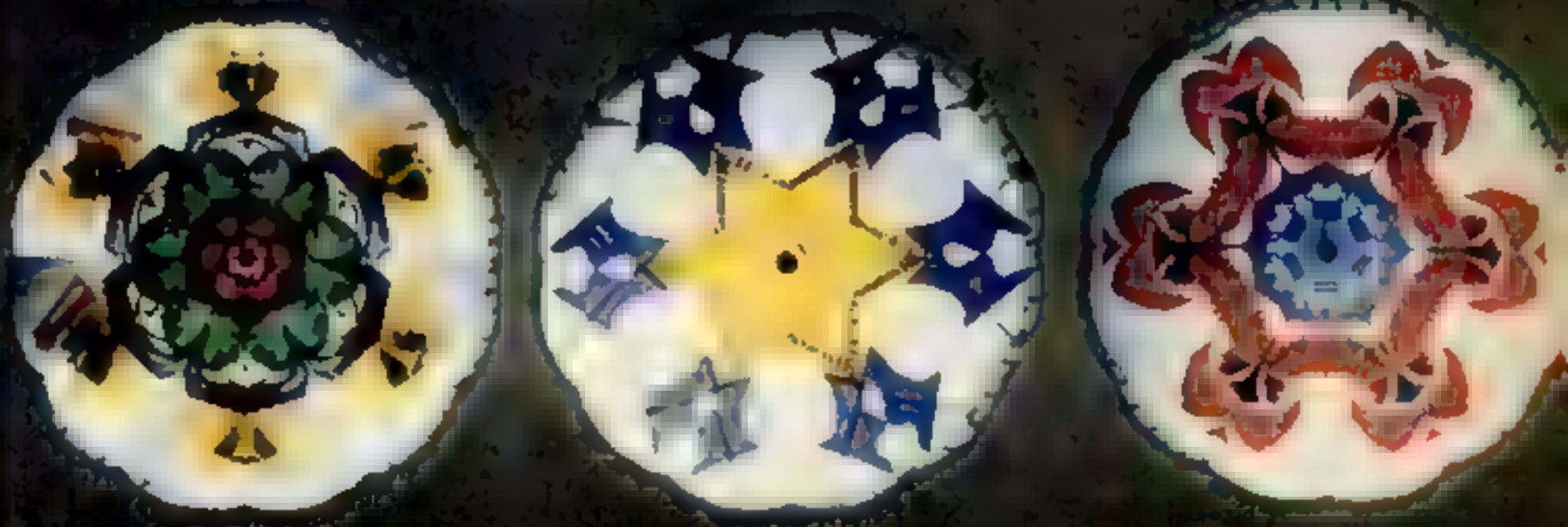
VISITORS to London about 1816 were amazed to see people in the streets gazing skyward through pasteboard tubes. But these watchers were peering at no eclipse or comet. They were fascinated by a scientific novelty that had taken London by storm—the kaleidoscope, invented by Sir David Brewster. First regarded only as a toy, it was soon adopted by artists as an aid in originating new designs. Sir David named his invention by combining three Greek words: *kalos*, meaning beautiful, *eidos*, form, and *skopeo*, I see. Almost anyone who has looked through a kaleidoscope will agree that the name is appropriate.

Two mirrors on facing walls create the familiar illusion of an endless succession of walls. Multiple reflection also produces the pat-

POPULAR SCIENCE



Through the Kaleidoscope

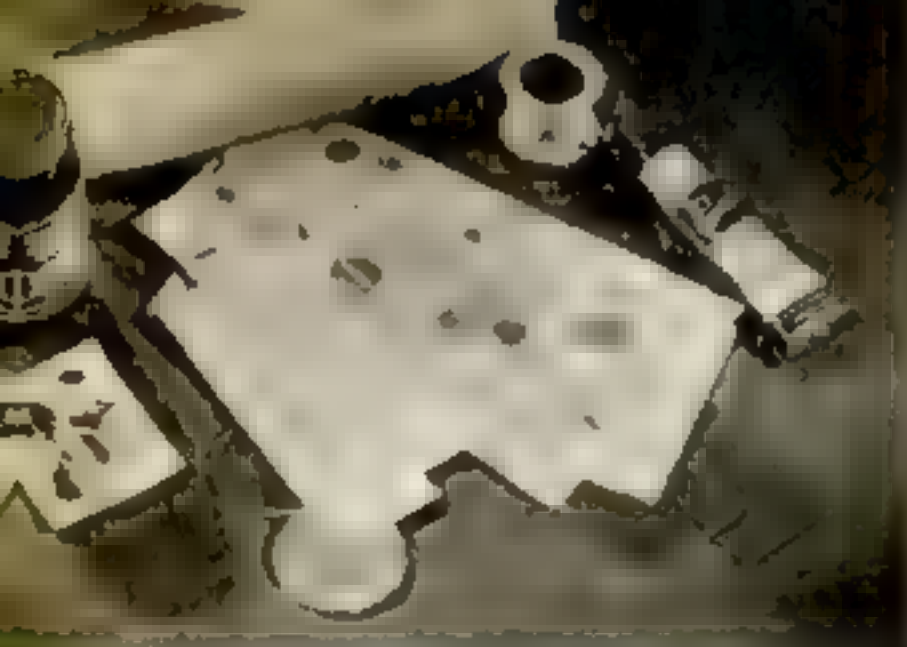


terns in a kaleidoscope, but the mirrors are joined at one edge, so that the reflections form a circle. Their number depends upon the angle between the mirrors.

Because of the angle at which reflection occurs in a kaleidoscope, ordinary mirrors will produce a blurred double image—both the silver backing and the glass surface reflect light. The mirrors must be of the front-surface type. Unsilvered glass acts as such a mirror, particularly if its back

surface is blackened with paint or enamel.

Small kaleidoscopes can be bought at toy counters, but you can assemble one from common materials, and learn much about this fascinating device. Pictures on the following pages show step by step how to build a two-mirror kaleidoscope that will form twelve-unit patterns similar to those above. Three mirrors of the same size arranged triangle fashion will form six-unit designs and multiply each into an all-over pattern.

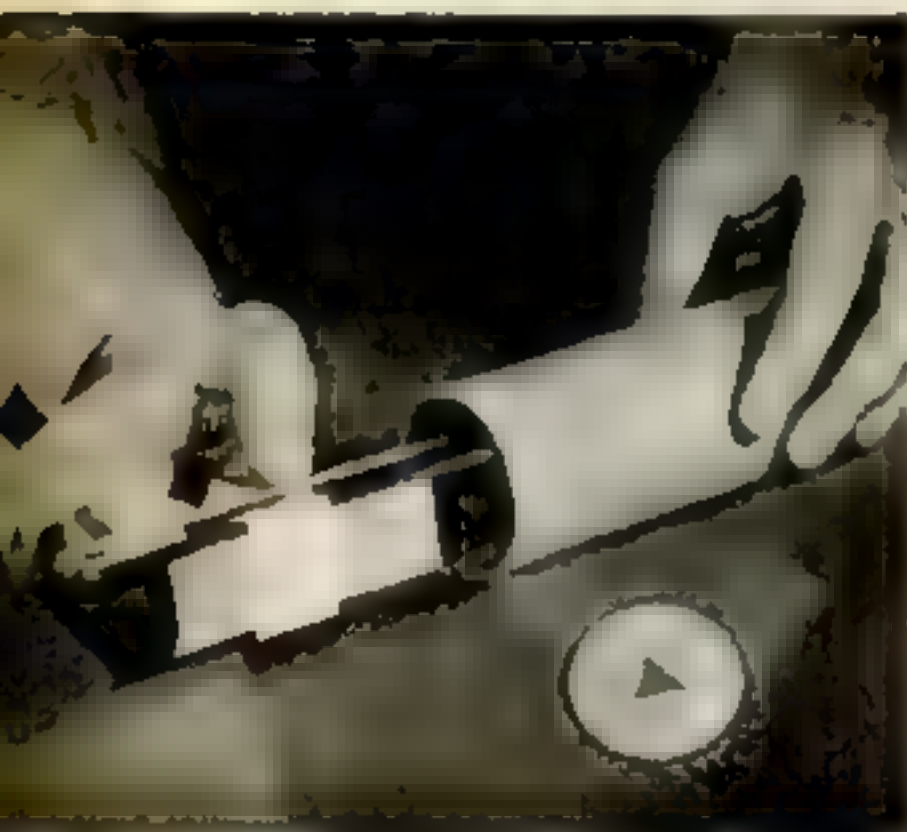


1 The kaleidoscope on page 110 was made from these parts: a 2" by 9" mailing tube, two glass strips $1\frac{1}{8}$ " by 9", a frosted and a clear glass disk, black paint, tape, cement, cardboard, plastic scraps, and covering paper

2 Sizes are not critical if correct proportions are maintained. Any tube can be used, provided the glass strips are cut to fit inside at an angle of 30 deg. They should be about four times as long as they are wide. Coat one side of each with black paint or enamel

5 Tape the spacing strip in place to hold the mirrors 30 deg. apart. Be sure the painted surfaces are outside; then slide the mirrors into the tube as in the photo below. If they fit loosely, wrap a sheet of paper about them

6 Push the mirrors $\frac{1}{8}$ " inside the end of the tube. So placed, they should reach to within about $\frac{7}{8}$ " of the other end. This will leave ample room for the load. Apply cement thinly inside the $\frac{1}{8}$ " space and to the edge of the eyepiece, and press this into place



9 It is interesting to experiment by varying the amount of the load and using scraps of different colors. To view the patterns, press the frosted disk into place. When the load is satisfactory, secure the disk by cementing it

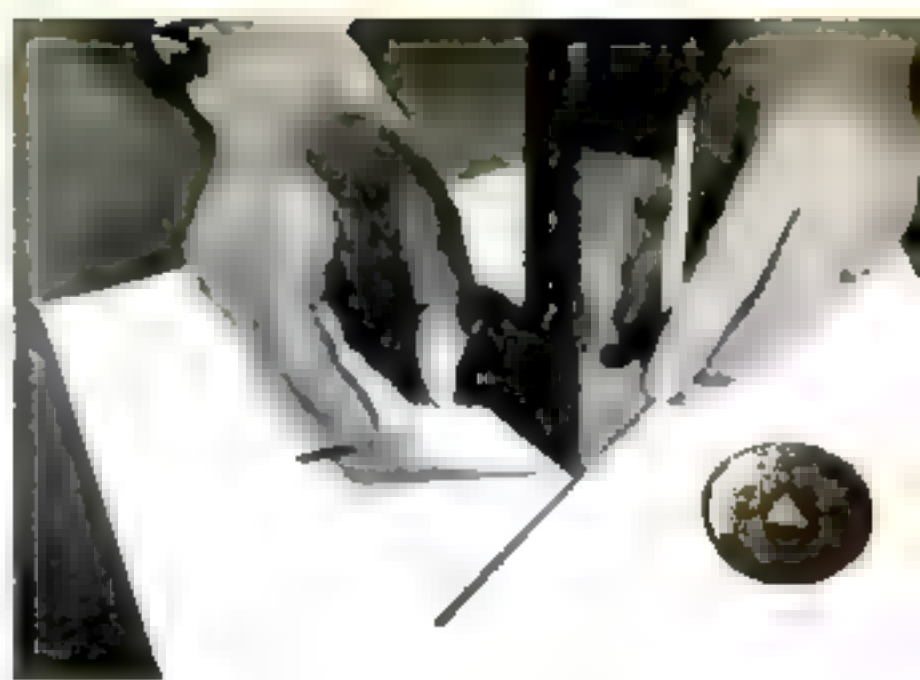
10 You can improve the outward appearance of your kaleidoscope by wrapping the tube in some gaily colored decorative paper. The kind used for Christmas packages is ideal. Clear model-airplane dope, lacquer or varnish will prevent injury from frequent handling





3 While the painted glass is drying, cut a disk out of stiff cardboard, making it a close fit inside one end of the tube. At the center punch a $\frac{1}{4}$ " peep-hole. If no punch is available, use a sharp knife to cut a triangular hole $\frac{3}{8}$ " on a side, as shown above

7 Turn the tube around and push the clear glass disk into it right against the ends of the mirrors. A little cement may be spread around the edge. Now cut a cardboard strip $\frac{5}{8}$ " wide and long enough to overlap inside the tube. Cement it fast as in the photo

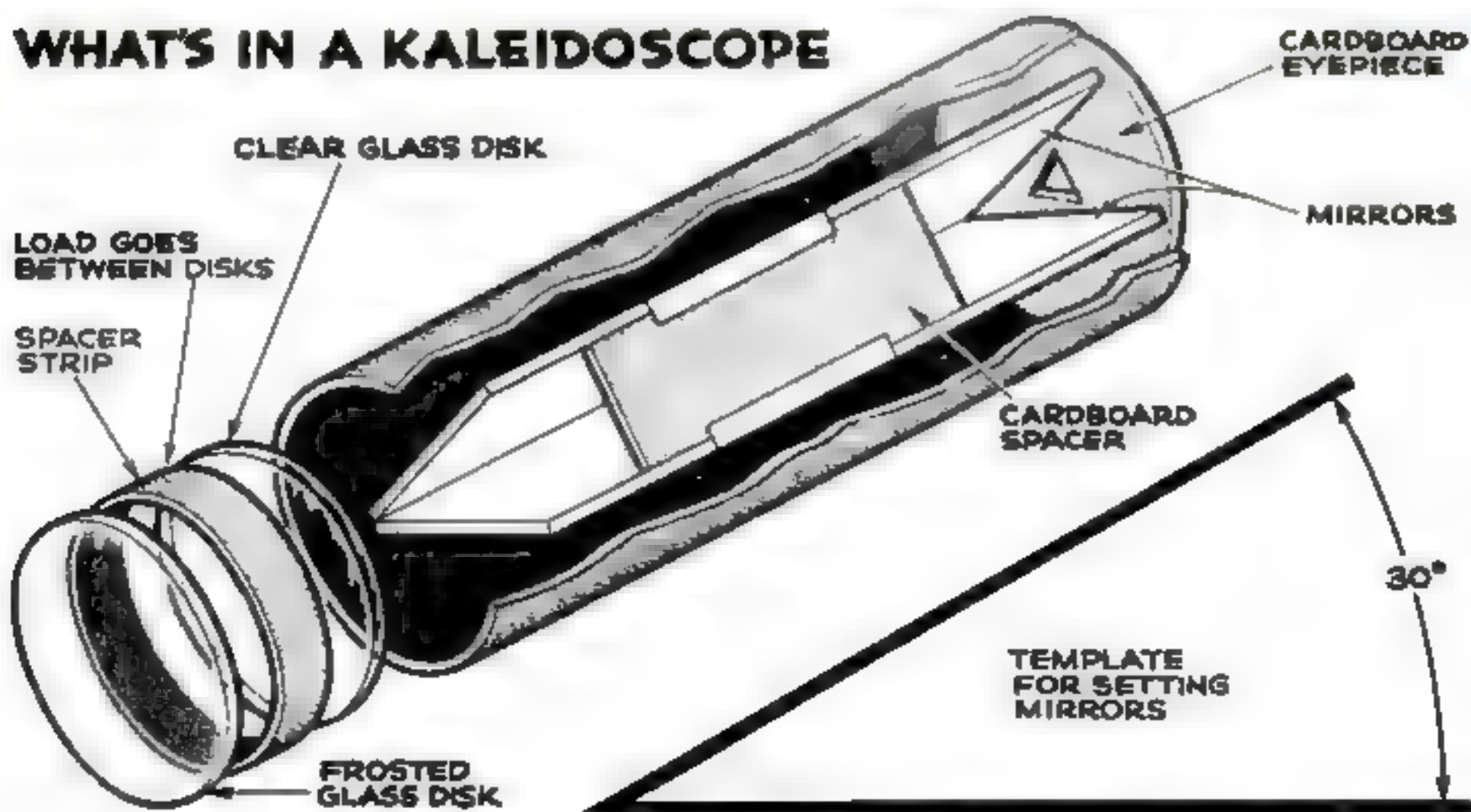


4 When the paint is dry, join the mirrors at one edge with adhesive tape, the unpainted sides facing. Set them on a drawn angle of 30 deg. or on the diagram below. Cut a cardboard spacer to fit closely within the outer edges

8 You are now ready to add the load. Bits of colored plastic, broken glass, beads, and scraps of celluloid are suitable. All should be translucent or transparent. Carved pieces, notched edges, and saw cuts yield odd effects



WHAT'S IN A KALEIDOSCOPE

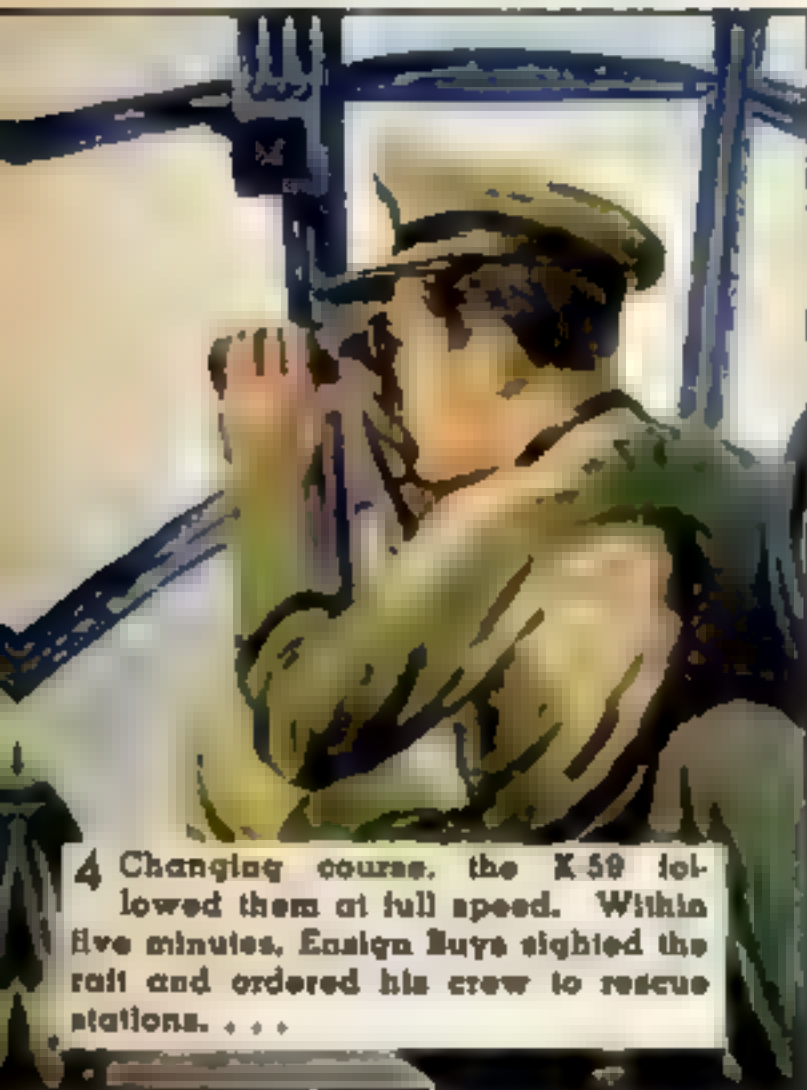


How the First Sea-Air Rescue Was Made

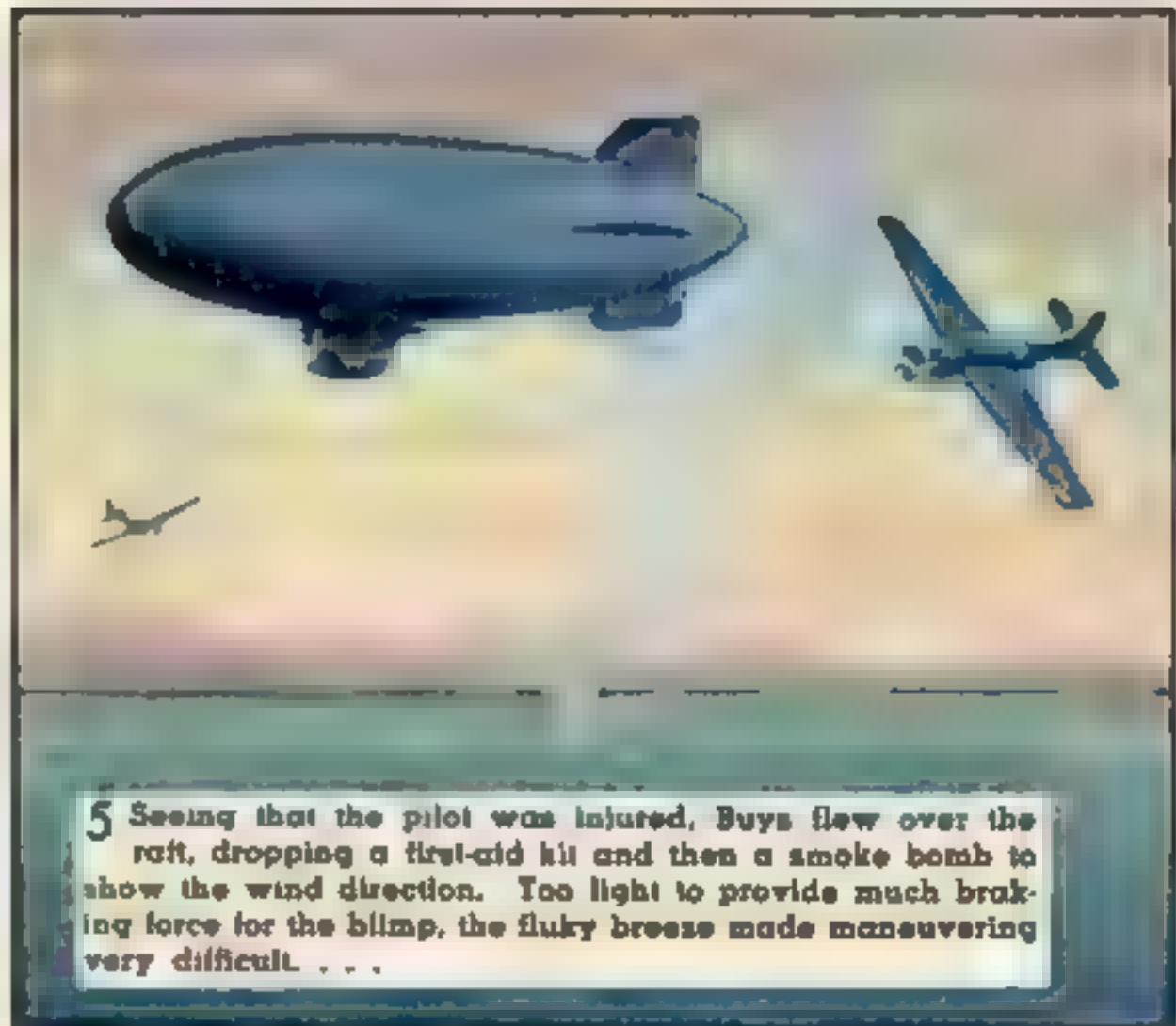
By FRANK TINSLEY

Our Navy blimps are versatile. They can rise vertically, hover, and cruise at low altitudes. They're poison to U-boats; no blimp-escorted convoy has lost a ship to a submarine. Now the lighter-than-air craft have won new laurels. . . .

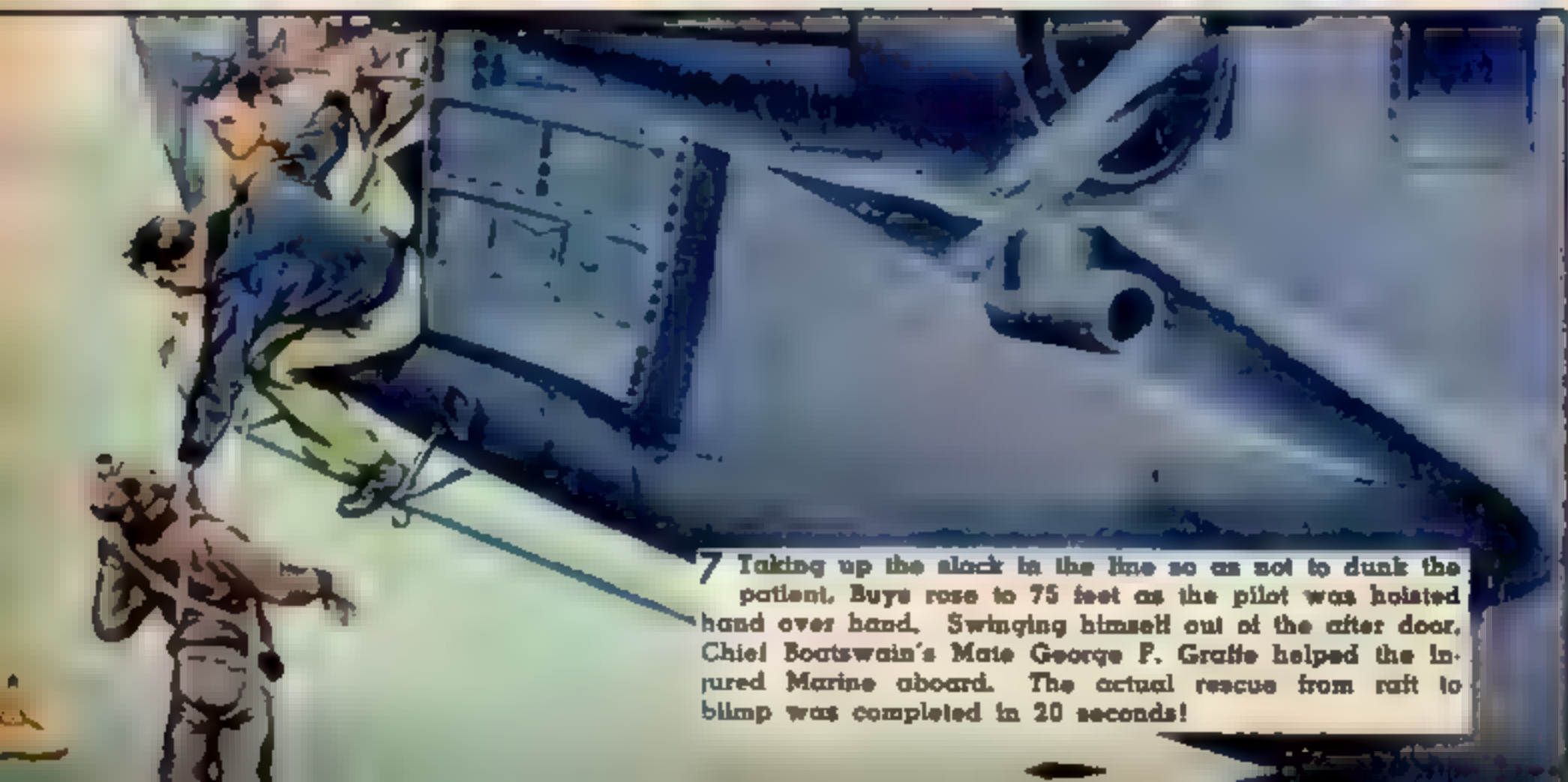
1 While on a routine coastal patrol, the airship K-59, under the command of Ensign Lowell E. Buys, recently effected the first sea-to-air rescue in the annals of aviation!



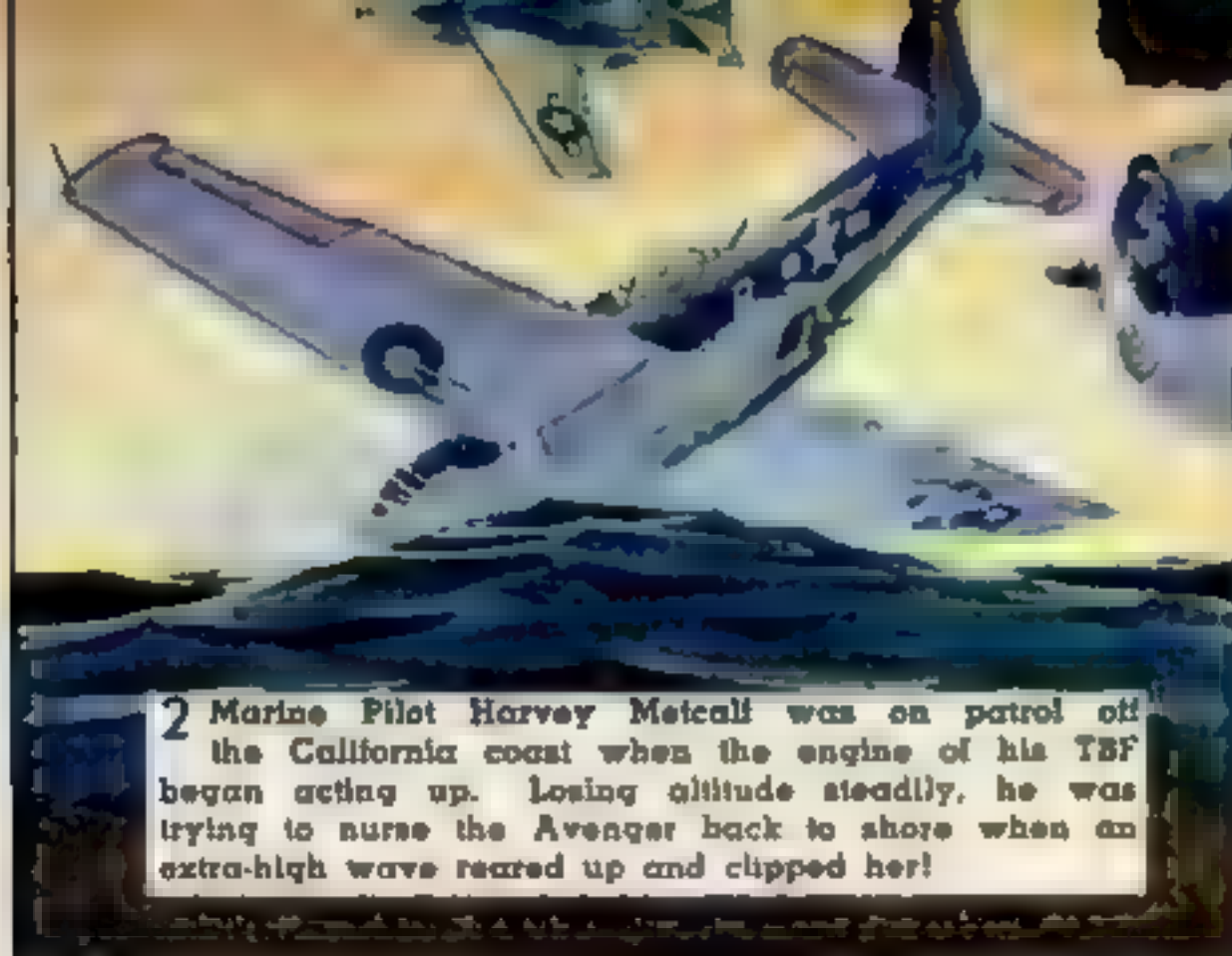
4 Changing course, the K-59 followed them at full speed. Within five minutes, Ensign Buys sighted the raft and ordered his crew to rescue stations. . . .



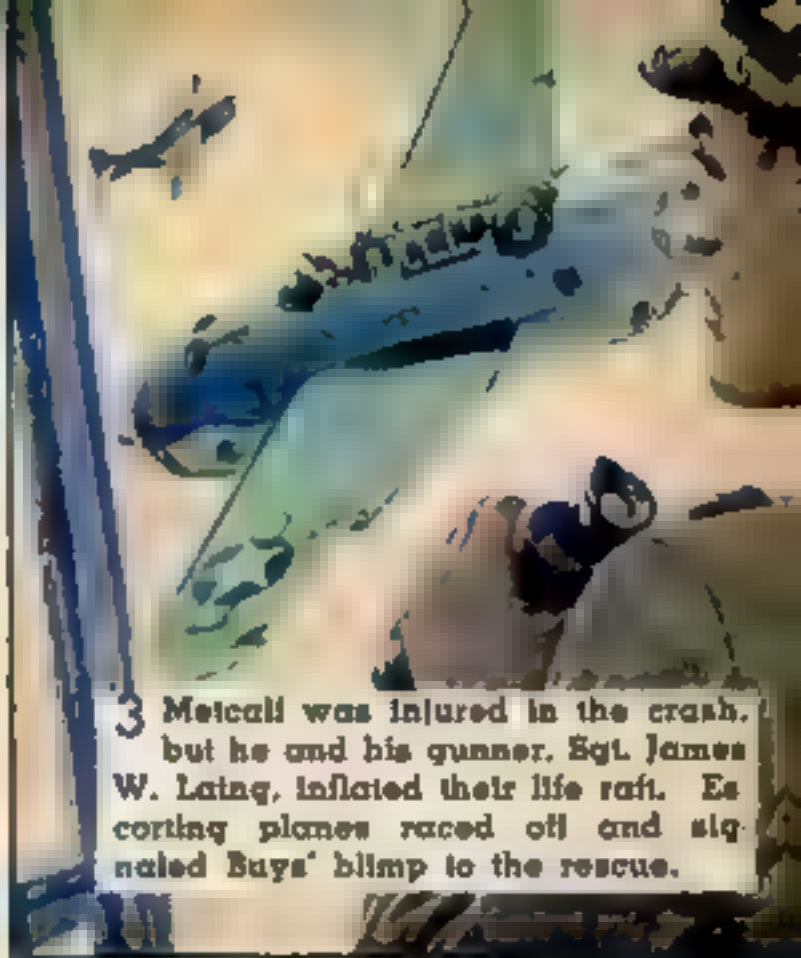
5 Seeing that the pilot was injured, Buys flew over the raft, dropping a first-aid kit and then a smoke bomb to show the wind direction. Too light to provide much braking force for the blimp, the fluky breeze made maneuvering very difficult. . . .



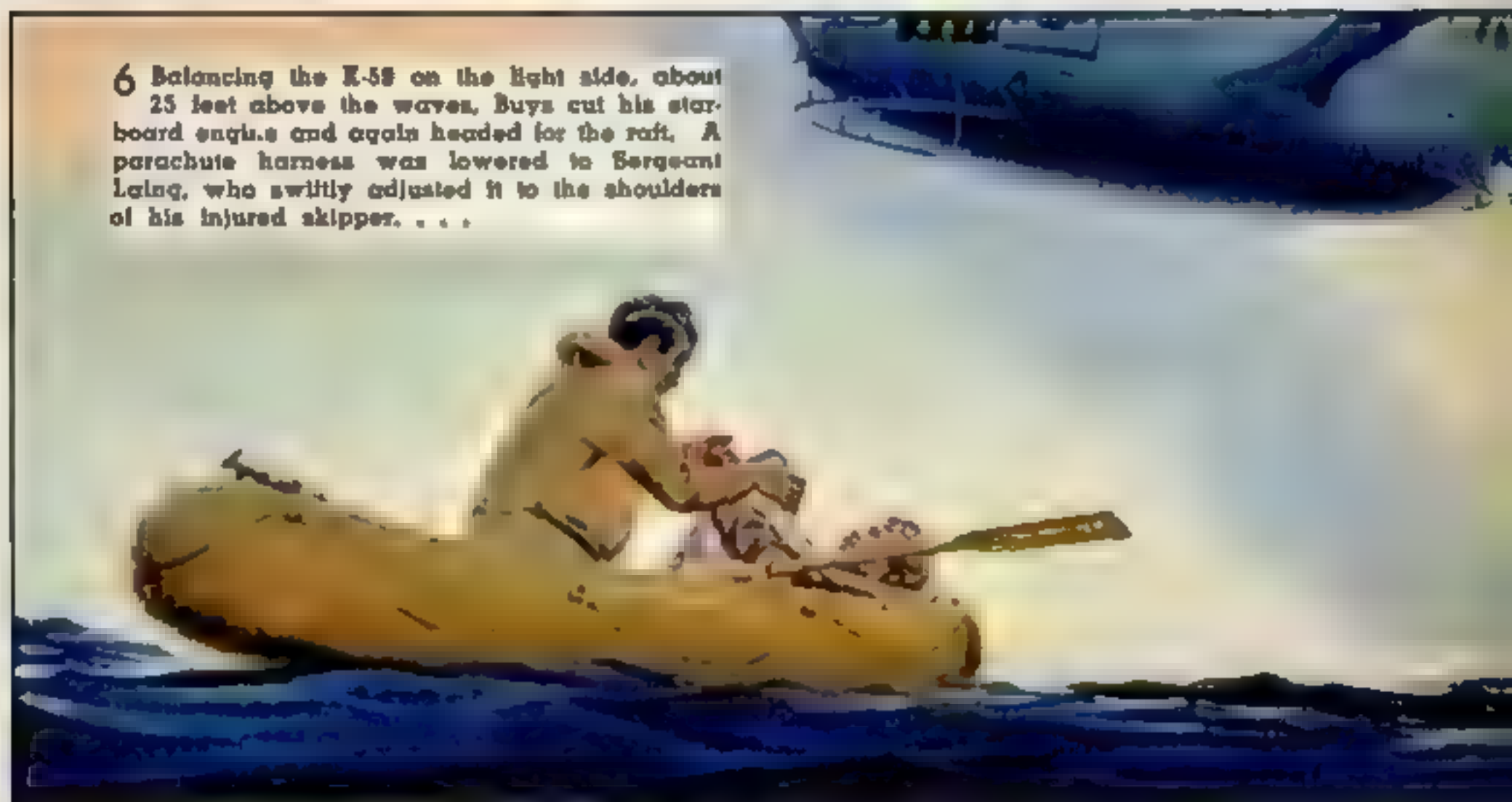
7 Taking up the slack in the line so as not to dunk the patient, Buys rose to 75 feet as the pilot was hoisted hand over hand. Swinging himself out of the after door, Chief Boatswain's Mate George F. Gratie helped the injured Marine aboard. The actual rescue from raft to blimp was completed in 20 seconds!



2 Marine Pilot Harvey Metcalf was on patrol off the California coast when the engine of his TBF began acting up. Losing altitude steadily, he was trying to nurse the Avenger back to shore when an extra-high wave reared up and clipped her!



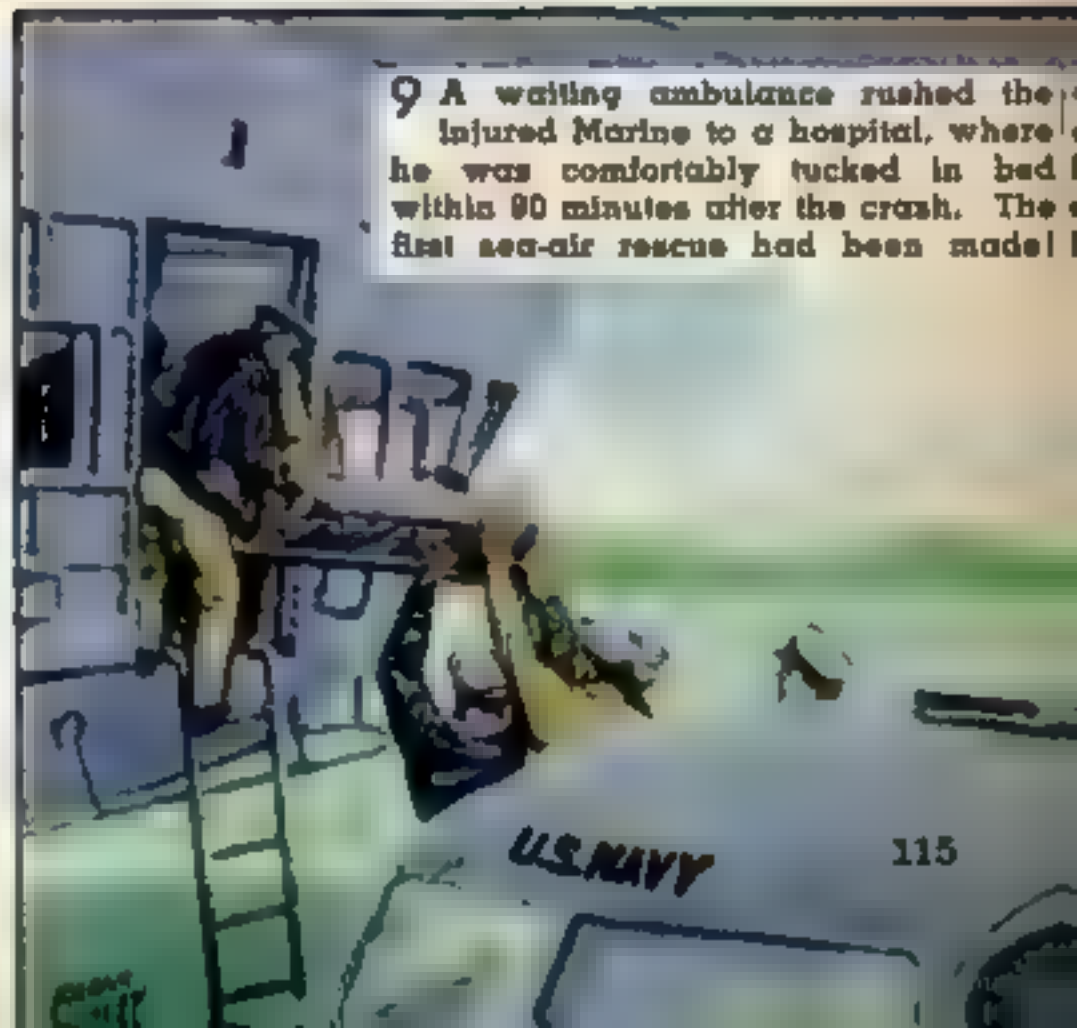
3 Metcalf was injured in the crash, but he and his gunner, Sgt. James W. Lainq, inflated their life raft. Escorting planes raced off and signaled Buys' blimp to the rescue.



6 Balancing the K-58 on the light side, about 25 feet above the waves, Buys cut his starboard engine and again headed for the raft. A parachute harness was lowered to Sergeant Lainq, who swiftly adjusted it to the shoulders of his injured skipper. . . .



8 Safely aboard, Metcalf was given first aid. Leaving Lainq to be rescued by a PBV, the K-58 headed for shore.



9 A waiting ambulance rushed the injured Marine to a hospital, where he was comfortably tucked in bed within 90 minutes after the crash. The first sea-air rescue had been made!

PLANES WILL LAND at night on glowing fields instead of under glaring floodlights if the invention of Eulalia C. Henderson and George Stallard, of San Francisco, is put to use by airports. The new landing surface would be composed of spring-anchored translucent blocks, illuminated from below by electric lights. Such construction provides a cushioned, nonskid surface; as the plane lands, the undepressed sections act as a brake when they are met by the wheels. The warmth generated by the lights is expected to melt ordinary ice and snow, but supplementary heat may be used if necessary.

TRANSPARENT PANELS

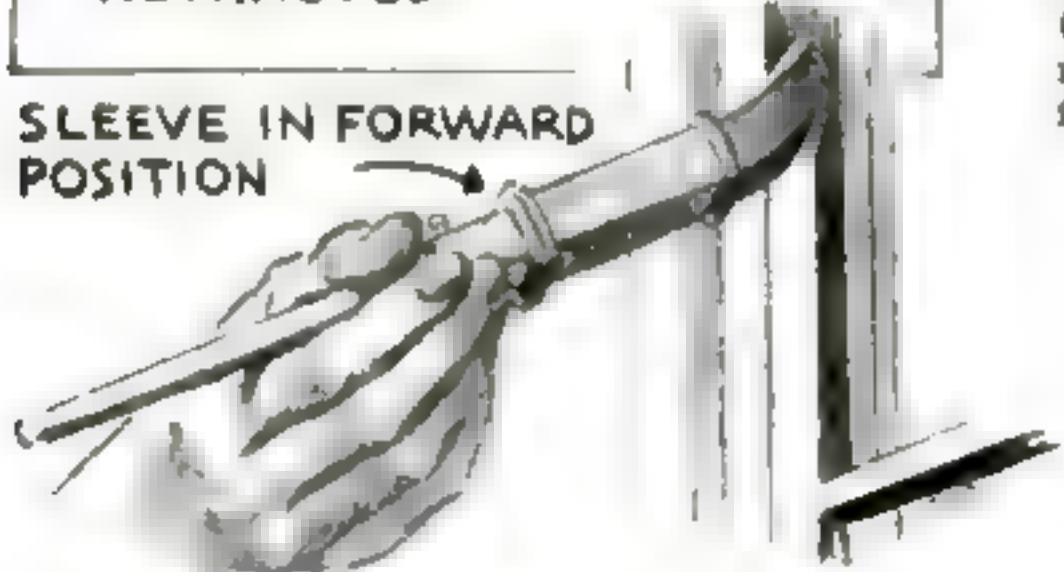


HOW BIG IS A PIECE OF PIE? The question is answered for boarding-house and restaurant keepers with a device, originated by Morris Leve, of Los Angeles, that simplifies the division of a pie into almost any given number of equal parts. This new pastry gauge, made of sheet metal to fit over a pie, is graduated with lines to act as guides in cutting. A pin in the center of the bail-type handle indicates the center of the pie. Cuts are made between this point and marks on the circumference of the gauge.

WITH SLEEVE RETRACTED



SLEEVE IN FORWARD POSITION



PULL DOWN THE GIRDLE and you have a smaller paintbrush. Harry A. Rishel, Ambler, Pa., has devised a brush that is adjustable to different-sized surfaces and varying conditions by merely sliding a built-in sleeve over the bristles. When the sleeve or girdle is retracted, the brush is adapted to broad, flat surfaces. When it is pushed forward, shortening the bristles, the brush may be used to paint narrow surfaces such as moldings and strips with less danger of smearing adjacent glass, screening, or hardware.



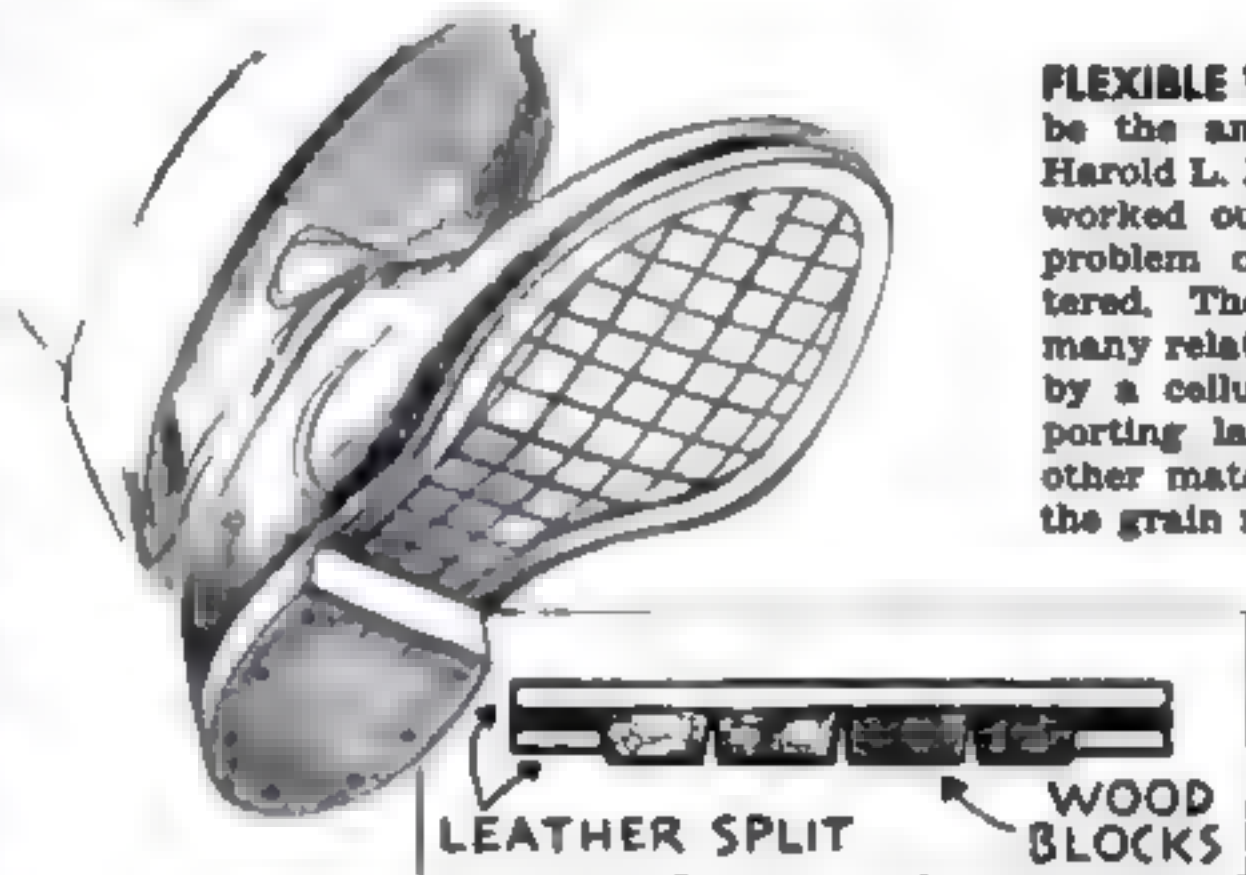
from the inventors

THAT UP-AND-DOWN MOTION that dentists tell us we should use in brushing our teeth is easily accomplished by the use of a new manually operated rotary toothbrush invented by Denis Borgeat, Montreal, Canada. The shape of the handle allows the user to take a firm grip and vary the pressure of the brush against the teeth. Since the bristles are arranged in a spiral sequence, there is a transverse as well as vertical brushing motion. The construction has been kept simple and open to enable the user to keep the brush clean and free from accumulations of toothpaste.

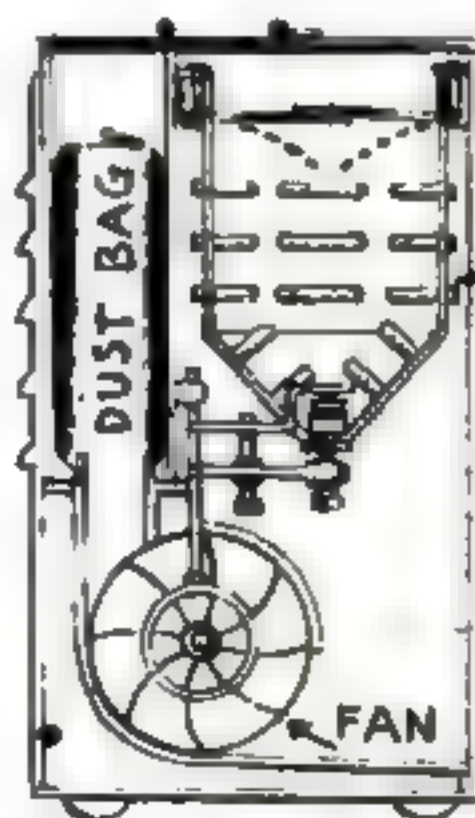


FLEXIBLE WOODEN SOLES for shoes may be the answer to the leather shortage. Harold L. Pierson, of Rochester, N. Y., has worked out a new type that solves the problem of stiffness heretofore encountered. The tread surface is composed of many relatively small wood units attached by a cellulose cement to a flexible supporting layer of a thin leather split or other material. The wood is cut so that the grain meets the flexible layer at right

angles, thus assuring a tight bond because of greater absorption of cement. The sole is flexible transversely as well as lengthwise. A waterproofing treatment keeps the wood from swelling when it gets wet.

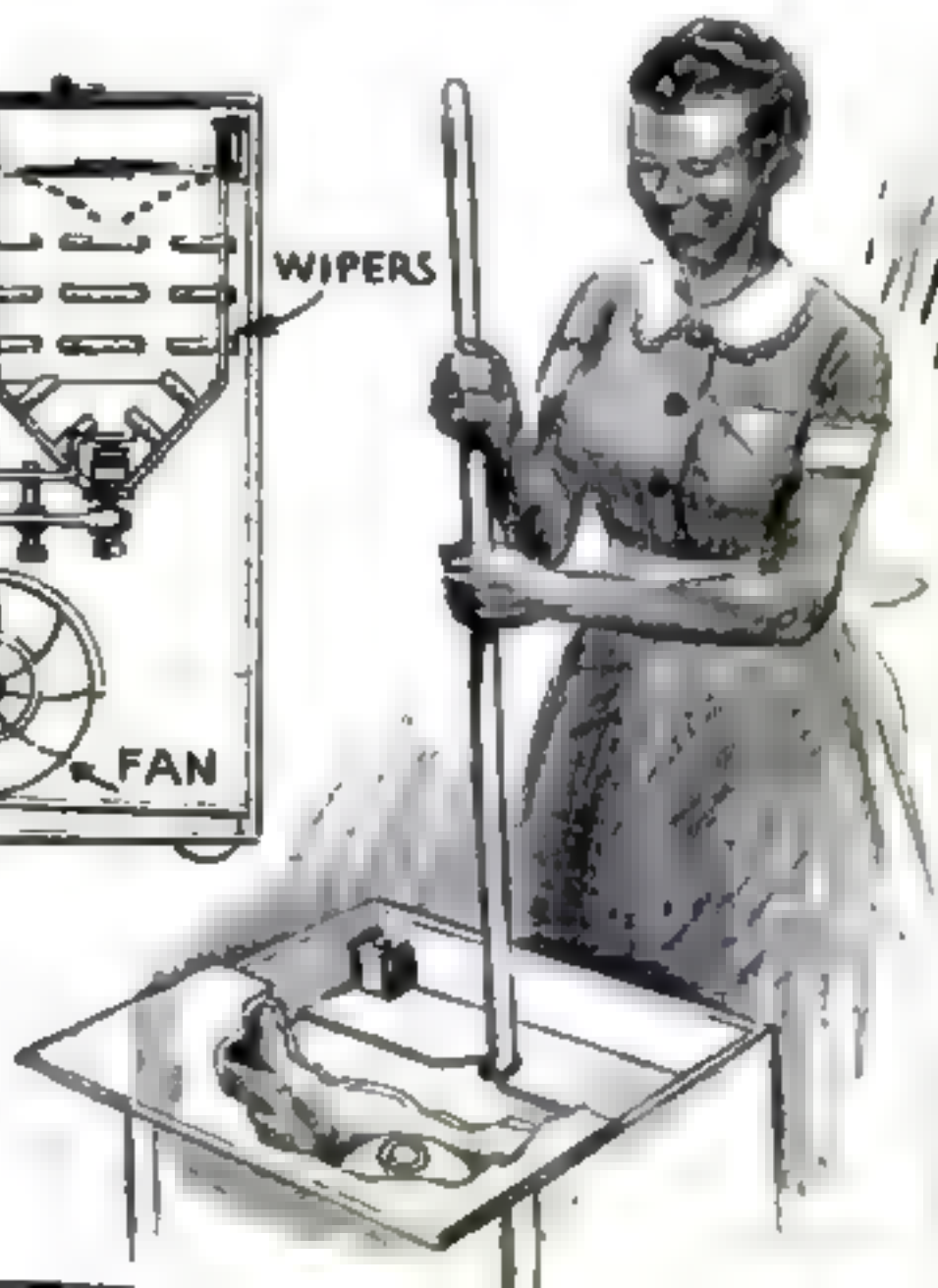


DON'T SHAKE THE DUST MOP out of the window. Use one of these contrivances that Cecil R. Curtia, of Los Angeles, designed to ease the burdens of tired housewives. After running the mop over dusty floors, you simply insert it in a box case, where it is mechanically agitated and a suction fan draws off those rolls of dust that will collect under beds and other furniture. The dust is automatically collected in a bag similar to that used on a vacuum cleaner. The device is so constructed as to be dustproof, and the agitators that dislodge the dust are cleverly fashioned to give the mop a wiping as well as a shaking treatment. Power for the apparatus is supplied by a conveniently controlled electric motor.



WIPERS

FAN



PARICUTIN IS ABOUT 19 MONTHS OLD

By DR. FREDERICK POUGH

Curator of Geology and Mineralogy,
American Museum of Natural History

MEXICO'S newest volcano continues to be the most interesting geological event of recent years. Starting in a cornfield on February 20, 1943, it has now reached a height of nearly 1500 feet. Because the cone is composed of ejected rock fragments it stands up steeply, but its walls have no strength. Hence, lava flows escape from the sides rather than spill over the top. Other

vents along the same fault fissure are active from time to time, making, late last fall, the subsidiary 210-foot cone known as Zapicho, and the more recently active Taquí flow orifice.

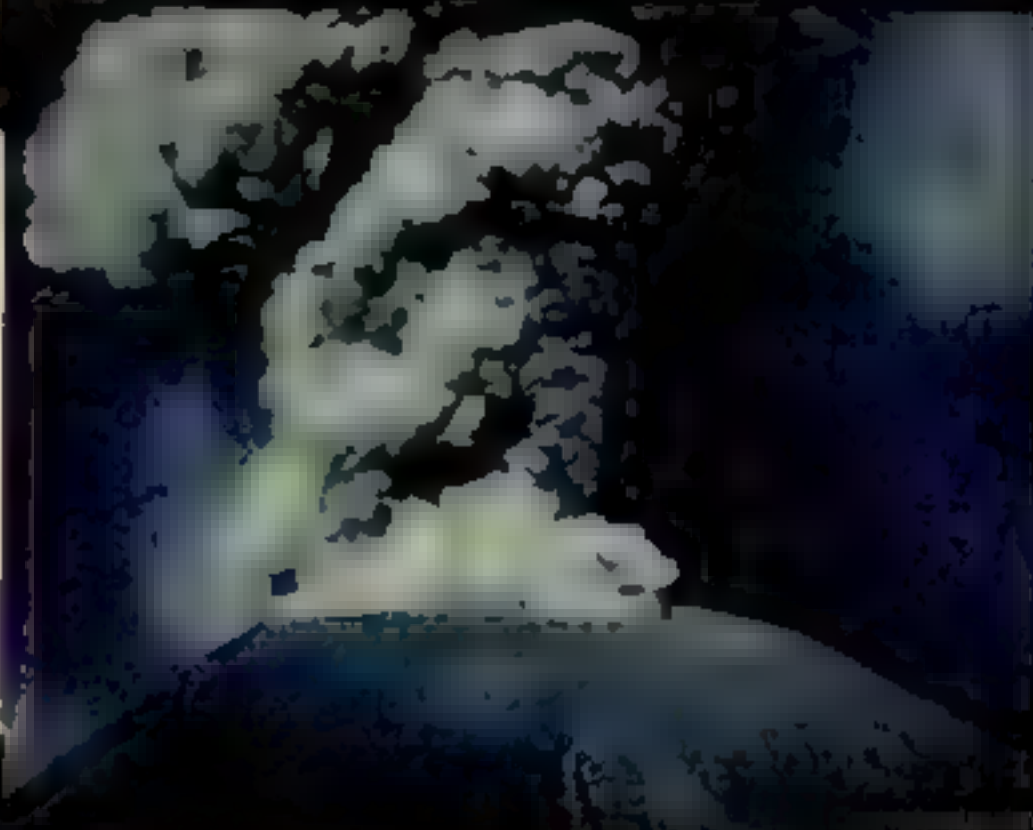
The development of Parícutín has been the finest opportunity geologists have ever had to follow the development of a cinder cone. Its small size and its accessibility have made it the ideal volcano laboratory of the world, and while it continues, it will be a mecca for scientists.

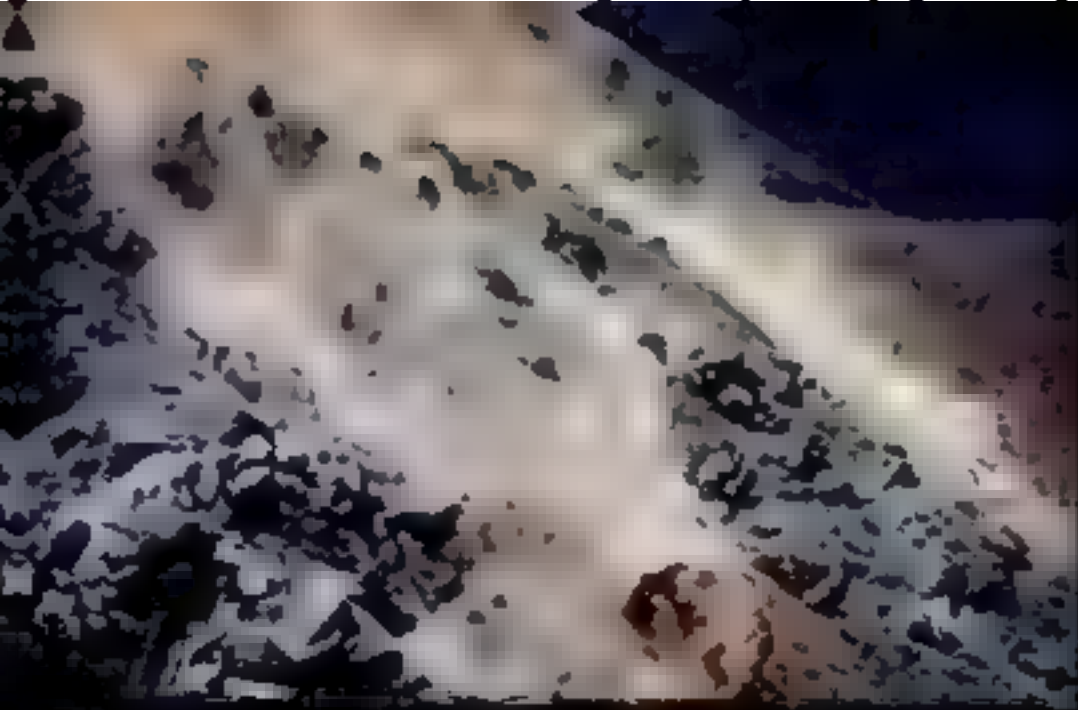


MEXICAN CINDER CONE, JUST 19 MONTHS OLD, IS LURE FOR SCIENTISTS

BOMBS, or masses of molten lava, are belched forth at incandescent heat, and, rounded by passage through the air, roll down the slopes of the volcano. One-hour exposure of the film resulted in the star trails visible in the night photo above.

IT'S DUST, in spite of the fact that it looks like smoke. The rising cloud of lava dust sometimes climbs five miles into the sky, darkening the countryside for miles around in most spectacular manner.





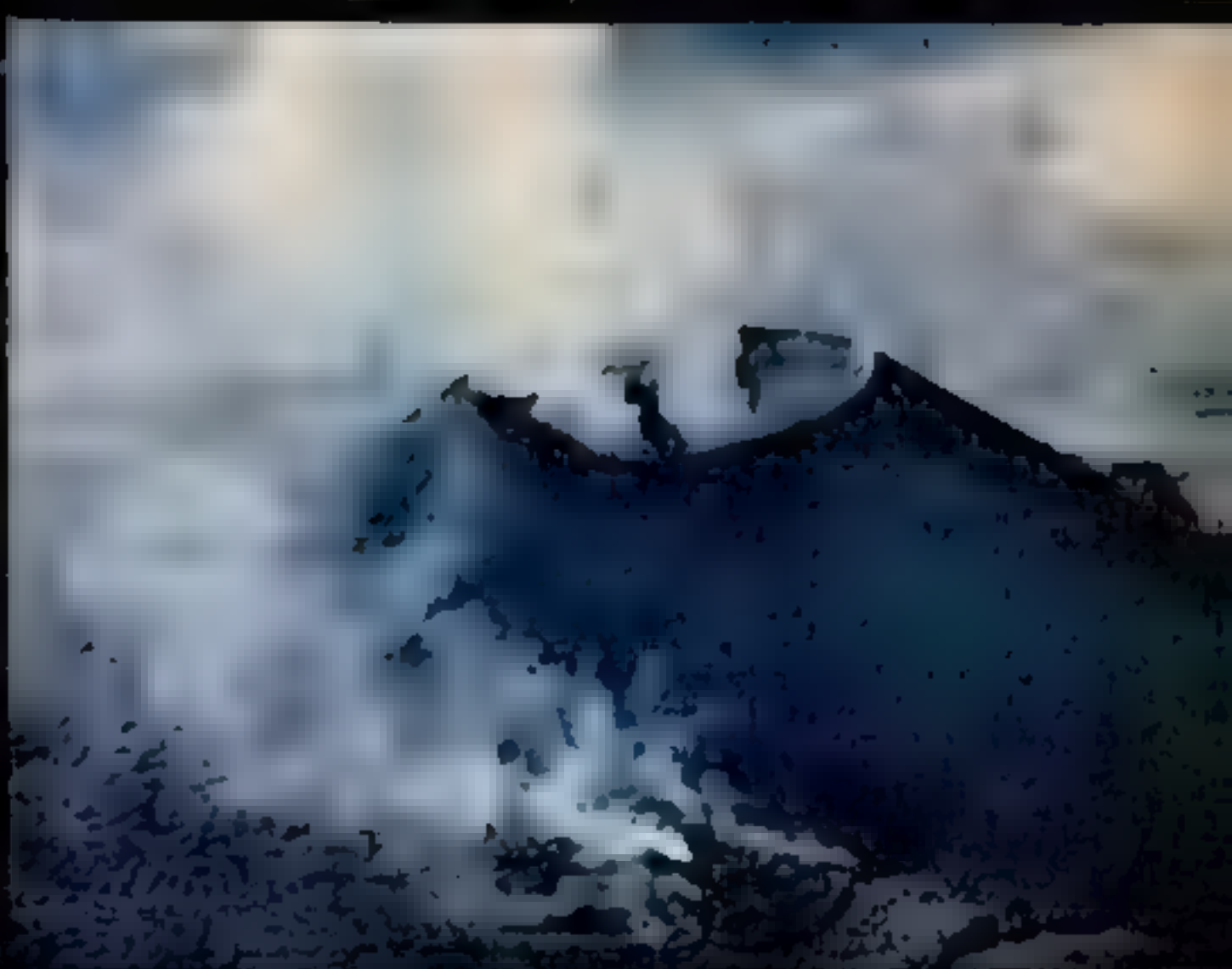
PLASTIC LAVA FLOW. Viscosity of early lava made it issue in thick masses and crumble away in huge boulders. Its advance was more similar to that of a rock slide than to the flow of a liquid



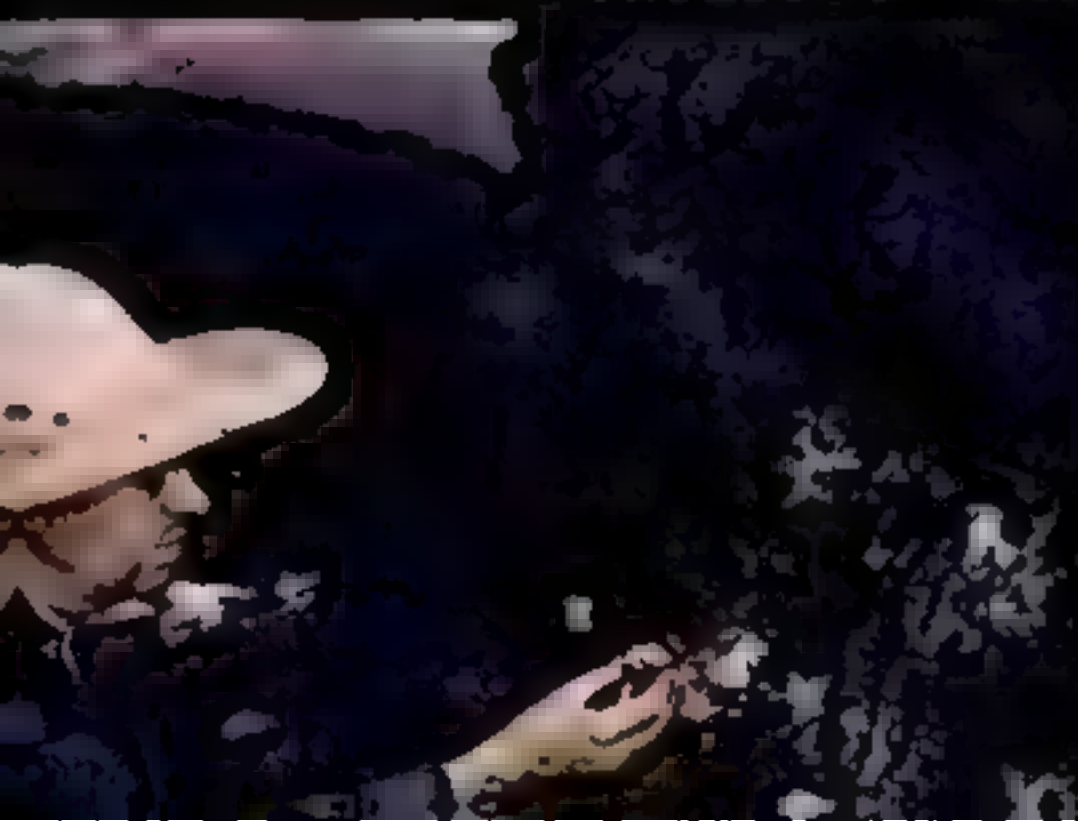
FLUID LAVA FLOW. Later flows have been hotter and more fluid. Fortunately, this fluid flow and the hydrostatically lifted lava fountain, lasting only half an hour, were photographed at the start



GRITTY DUST makes air pilots shy of flying over Parícutin. Dr. Paugh's expedition found that safe flying and clear vision could be had only in the early morning. The lava level in the throat of the volcano varied, occasionally being visible to the flyer in one of the vents, of which there were sometimes two or three. At the side may be seen white ammonium chloride gases escaping from vents, and the lava later

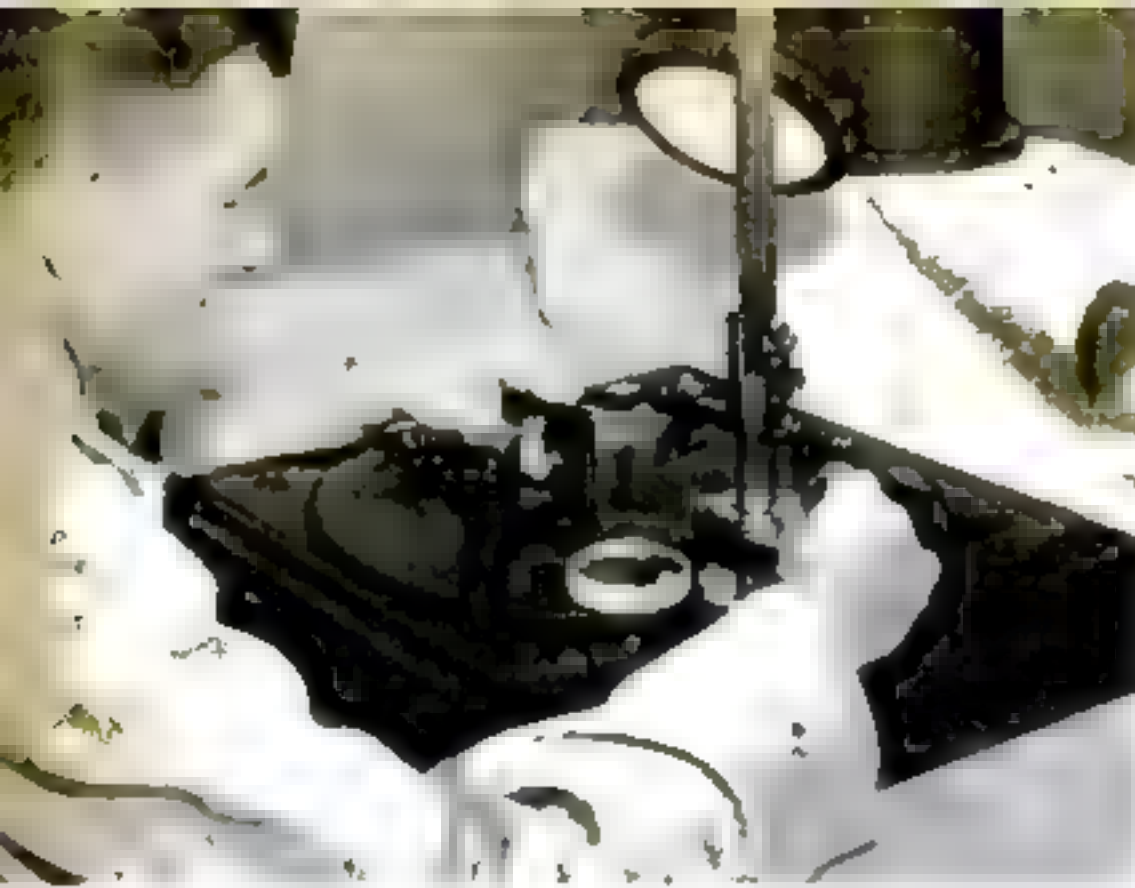


VOLCANO SALTS are being collected here by Dr. William F. Foshag, of the United States National Museum. These photos were made on 35-mm. Kodachrome with a Contax camera, Sennar f/2 lens



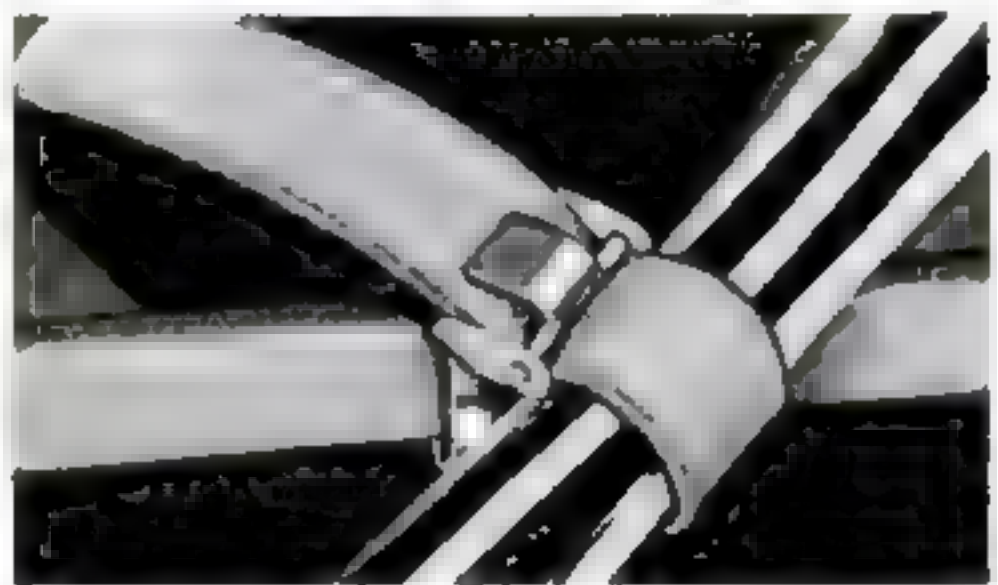
FLOWING LAVA LAKE is briefly revealed on the surface of one of the flows. Falling into a fissure, like batter stirred up by an egg beater, the lava escapes down a tunnel to reappear a mile away.



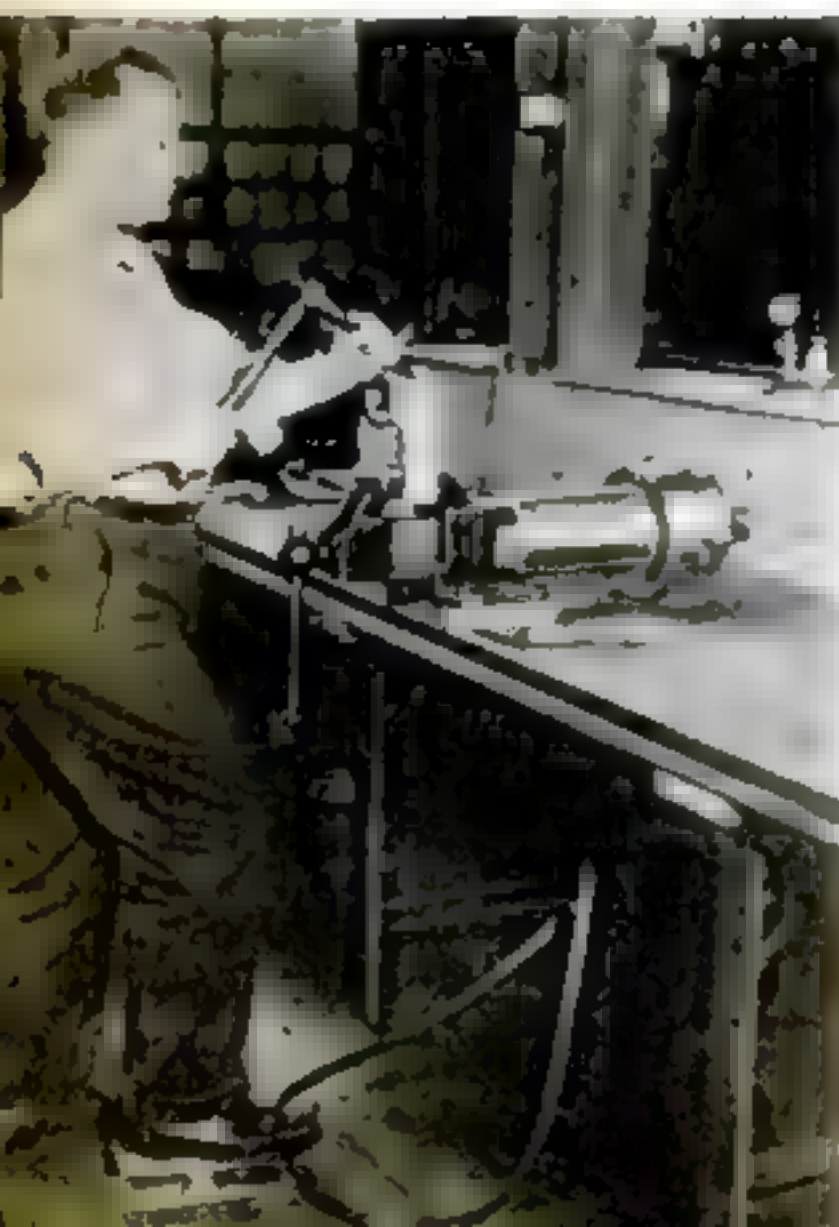


GLASS SURFACE PLATES, optically polished flat to 50 millionths of an inch, are offered by the George Scherr Co., Inc., of New York, as an accessory for precision gauging of height or measuring of flat and parallel surfaces. Made of annealed glass, the new plates, unlike the cast-iron plates they are intended to replace, are nonwarping and extremely abrasion-resistant.

"MIKE" READING that should banish eye squinting forever has arrived with the Magna-Eye—a plastic fitting that magnifies a micrometer's scale. Made by the Stebar Co., of Minneapolis, the "eye," because of the greater visibility it affords, is said to reduce faulty readings and consequent spoilage.



AN ELECTRIC-WIRE HARNESS STRAP made of synthetic-rubber-coated fabric and designed for quick installation or removal of the wires has been introduced by Adel Precision Products Corp., Burbank, Calif. The buckle, mounted on a full swivel latch, permits attachment at any angle.



PNEUMATIC POWER for 4 to 4½-inch vises is a new time-saving, hand-freeing development for bench workers. With the vise jaws preset to a desired opening, the pneumatic attachment at left quickly opens or closes the jaws a maximum distance of one inch by means of pressure on the heel or toe of an air-controlling foot pedal. Manufacturer is the Van Products Co., of Erie, Pa.

A "HANDY TRAY" that keeps small parts such as screws, nuts, and bolts at a worker's fingertips has been brought out by the Handi Equipment Co., of Jamaica, N. Y. Seventeen inches high and mounted on a non-tip-pable base, it has three tiers of four removable and interchangeable trays each, all revolving on a central pivot.





Our Cheap Little Stamped-Out Gun Proves a Champion

WHAT this country needed was a good, cheap submachine gun and that's just what it has now in the vicious little .45 caliber M-3 used by the U. S. Army. It's better than good; it's as nearly perfect as such a weapon can be. Weighing just under nine pounds, it is simple to operate, shoots at the rate of 450 rounds a minute, stands up under the toughest field conditions, and is easy to take down for cleaning. Assembly-line production of the M-3 is speeded by fabrication mainly from stamped parts that do not need complicated machine tools. It has only 25 component parts and 73 pieces, not counting the magazine



These are the parts of the M-3 after field stripping
1. Receiver; 2. Magazine; 3. Stock; 4. Trigger guard;
5. Magazine catch; 6, 7, 8, 9. Barrel, housing, bolt,
and trigger assemblies; 10. Trigger pin; 11. Sear pin



The M-3 is disassembled by (1) removing adjustable stock, pressing catch on left side of pistol grip, and pulling directly back. (2) Stock is then used to pry trigger guard out of pistol grip, and (3) housing assembly is removed by pulling down on its rear end and moving it back. (4) Barrel comes off by unscrewing it, and (5) the bolt group is withdrawn from front of receiver. After trigger pin is taken out, it is used to (6) dislodge sear pin, and (7) trigger assembly is removed from the receiver





First Air Force
East Coast, U. S. A.



Second Air Force
Middle West, U. S. A.



Third Air Force
South, U. S. A.



Fourth Air Force
West Coast, U. S. A.



Fifth Air Force
S. W. Pacific



Sixth Air Force
Caribbean



Seventh Air Force
Hawaii



Eighth Air Force
Great Britain



Ninth Air Force
Great Britain



Tenth Air Force
India-Near East



Eleventh Air Force
Alaska-Aleutians



Twelfth Air Force
North Africa



Thirteenth Air Force
South Pacific

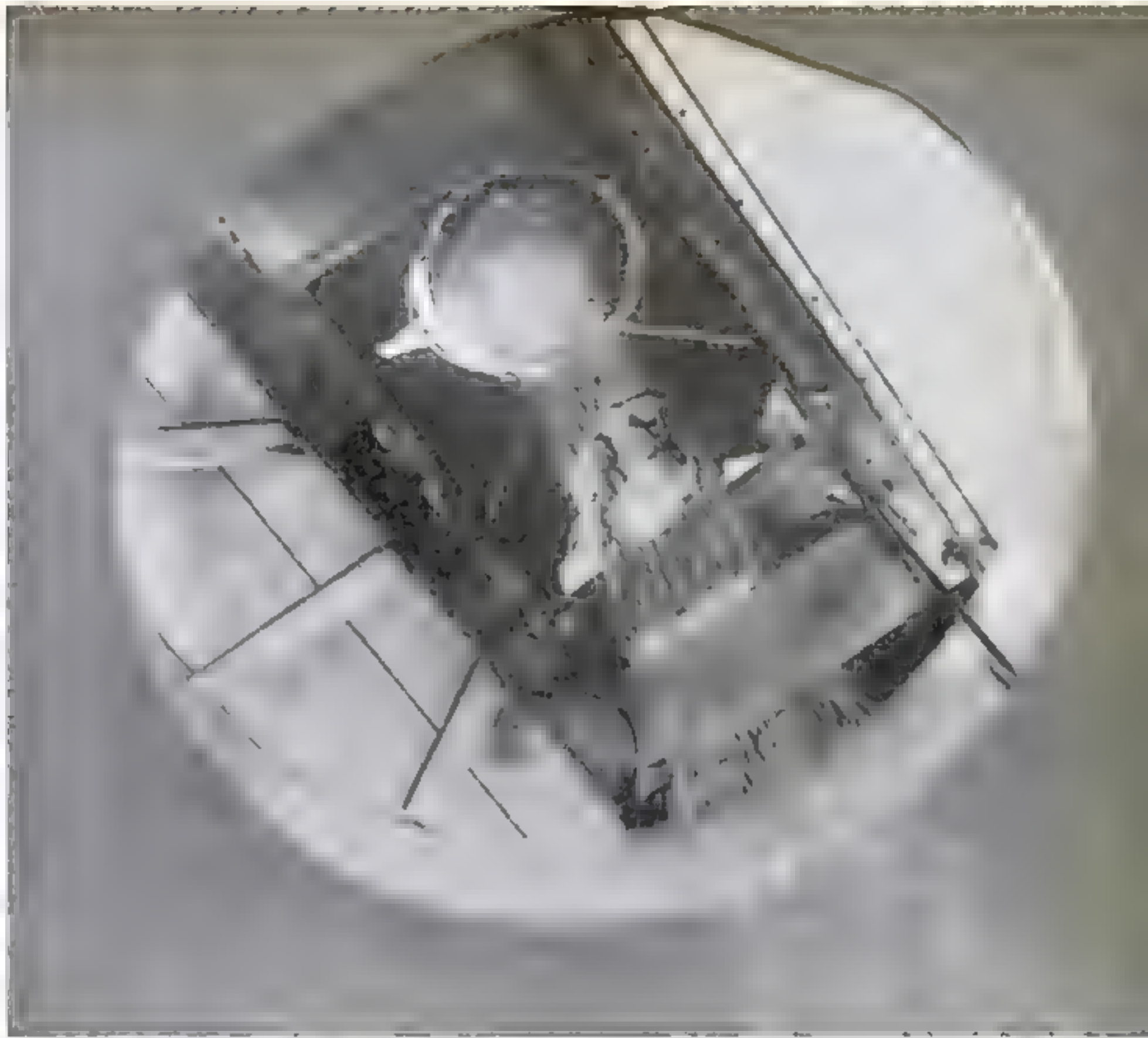


Fourteenth Air Force
China



Fifteenth Air Force
Italy

How many of these have you seen? Numbers and symbols identify our Army Air Forces. The Fifth in New Guinea, for instance, has the Southern Cross on its shoulder patch; the Sixth in the Caribbean, the flagship of Columbus; and the Fourteenth in China appropriately wears a flying tiger representing Gen. Claire L. Chennault's famous American Volunteer Group.



Photographs by
ROBERT F. SMITH

Shotgun pellets begin their career at the top of a shot tower where molten lead is poured into a dropping pan with a finely perforated bottom. Here you are looking upward at the shot as they start their downward journey

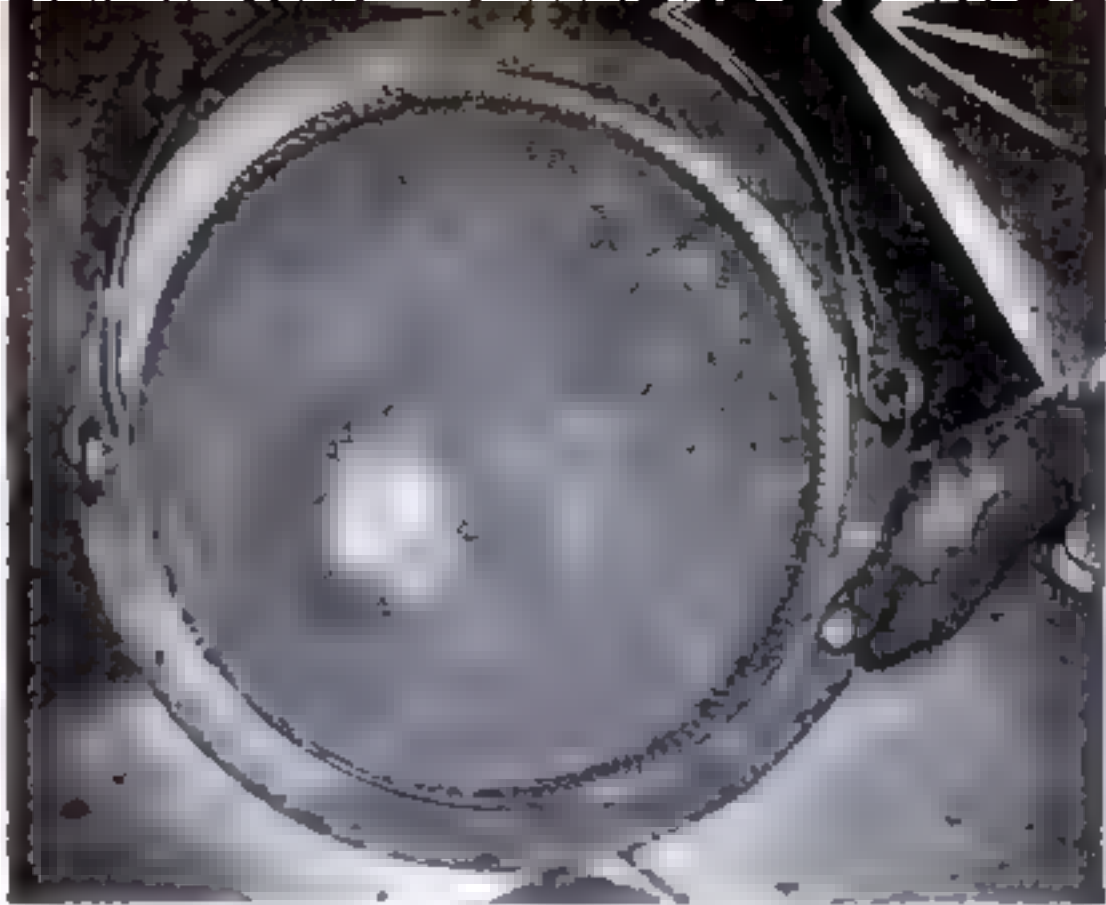
Gravity Molds Shot in a Modern Tower

Up-to-date manufacturing skill improves on a centuries-old idea to turn out the lead pellets for shotgun shells. Shot cull and sort themselves while rolling downhill through clever traps and hurdles.

MODERN mechanical ingenuity has added some interesting new wrinkles to the making of shot for shotgun shells, though the basic principle of dropping molten lead from a height to form bullets is still the same as it was away back before the Revolutionary War. In Washington's time, they used the Natural Bridge of Virginia for this purpose, and picked out the pellets by hand from the stream below. At the Winchester plant in New *(Continued on page 186)*



MELTING POT on ninth floor of the shot tower receives 98-pound pig of lead as one of the preliminary operations in the making of shot for shotguns



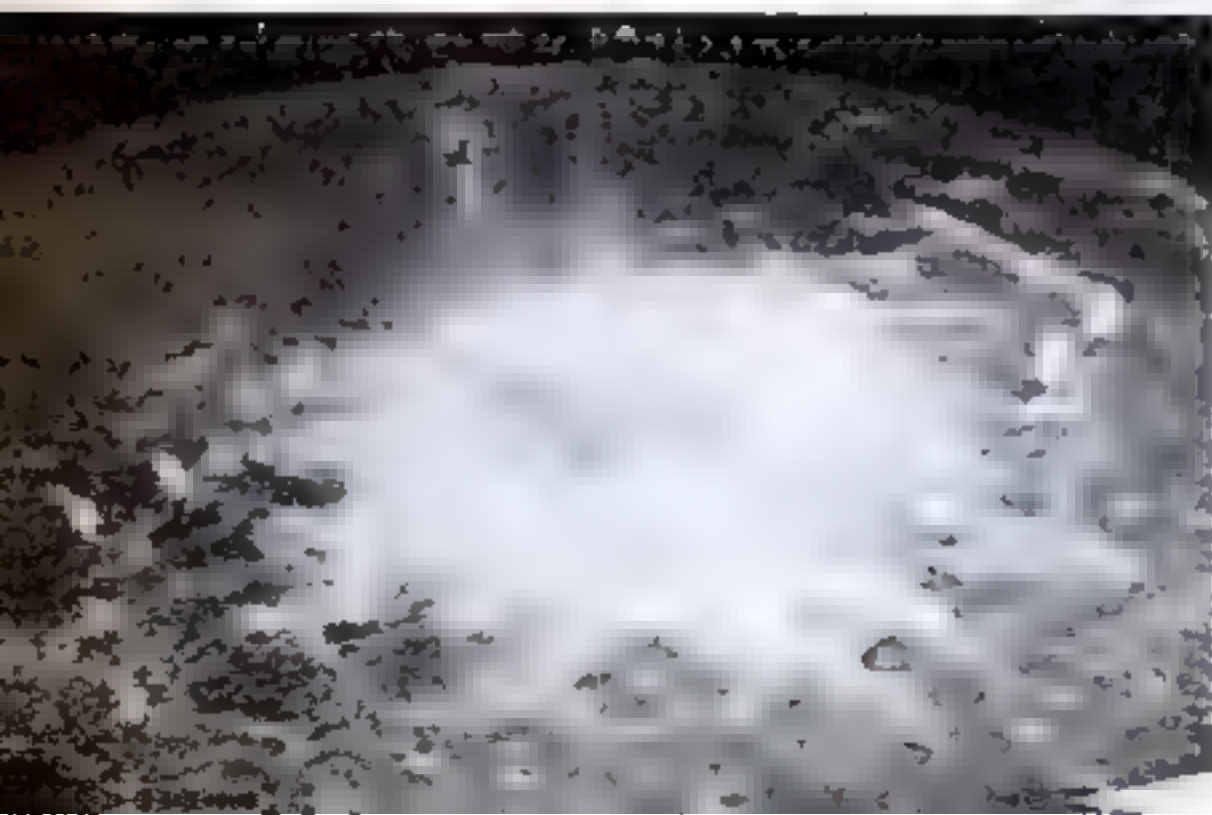
DROPPING PAN for No. 6 shot has 2,400 holes, each about the size of a fine pencil lead. These separate the molten metal into drop-lets that will form shot



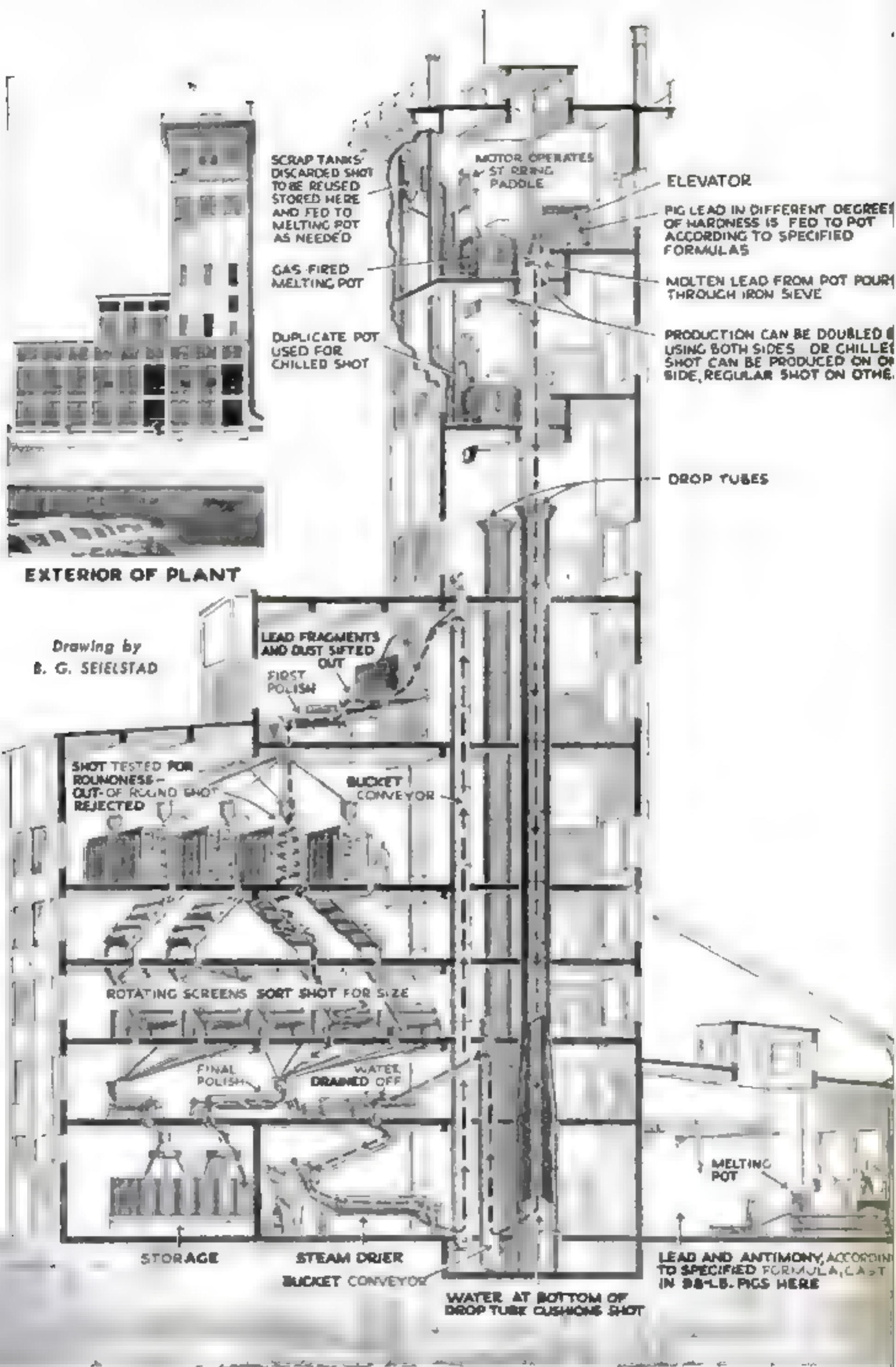
POURING the melted lead into the dropping pan iron rods are placed so as to break the force of the streams. Metal seeping through the holes in the dropping pan adheres to the bottom just long enough to form drops of proper size that harden as they fall



DROPPING at the rate of 9,911 pellets a second, these No. 6 shot become cool, solid spheres before reaching water cushion below. Five tons of lead an hour passes through 2,400 holes in the dropping pan to form 35,000,000 shot



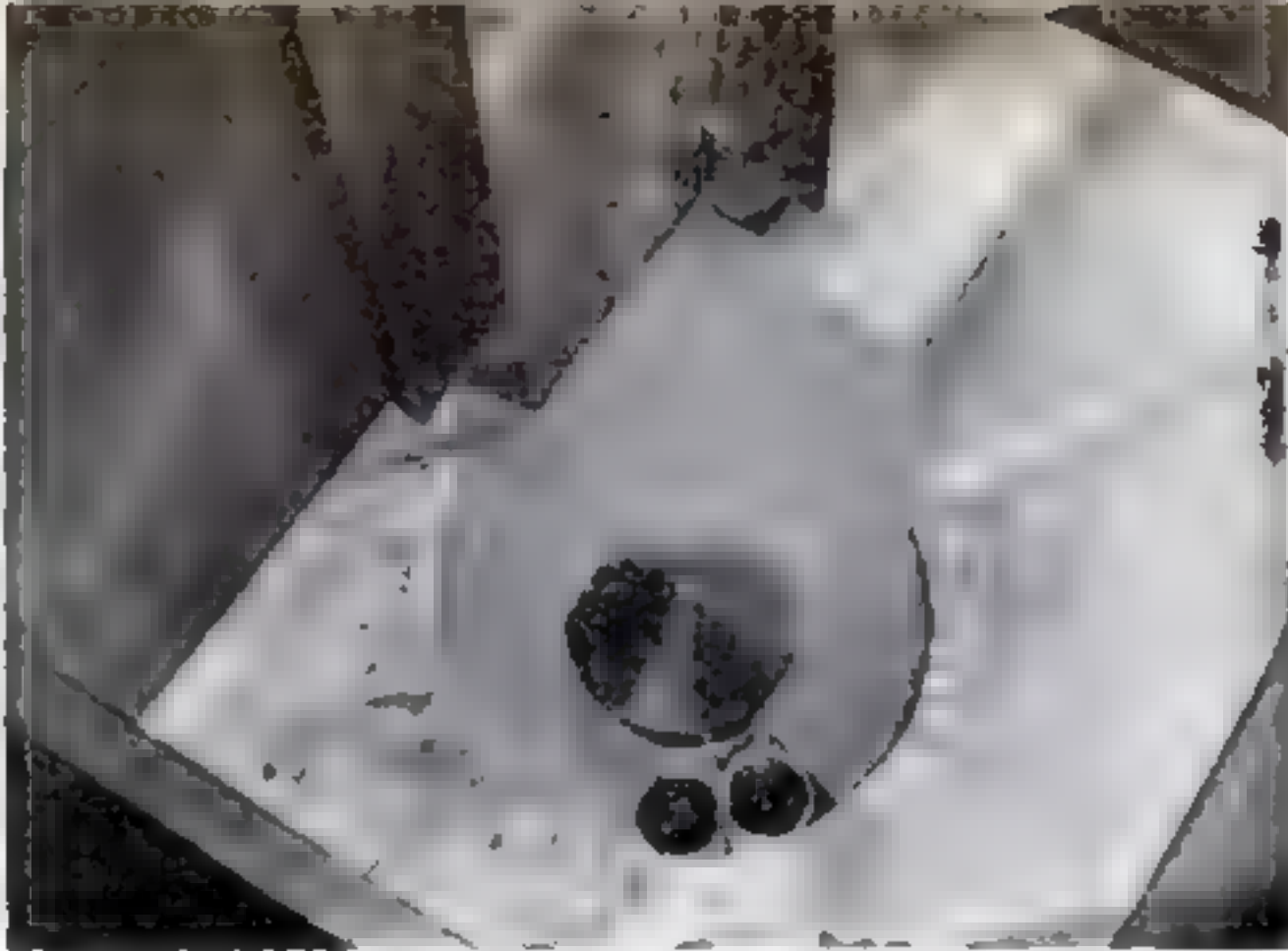
LANDING PLACE is a water tank at the bottom of the shot tower. Water is merely a shock absorber that prevents pellets from losing their shape. They sink into a trap from which they are picked up by a bucket elevator and carried to the second floor to be dried



Drawing by
B. G. SEIELSTAD

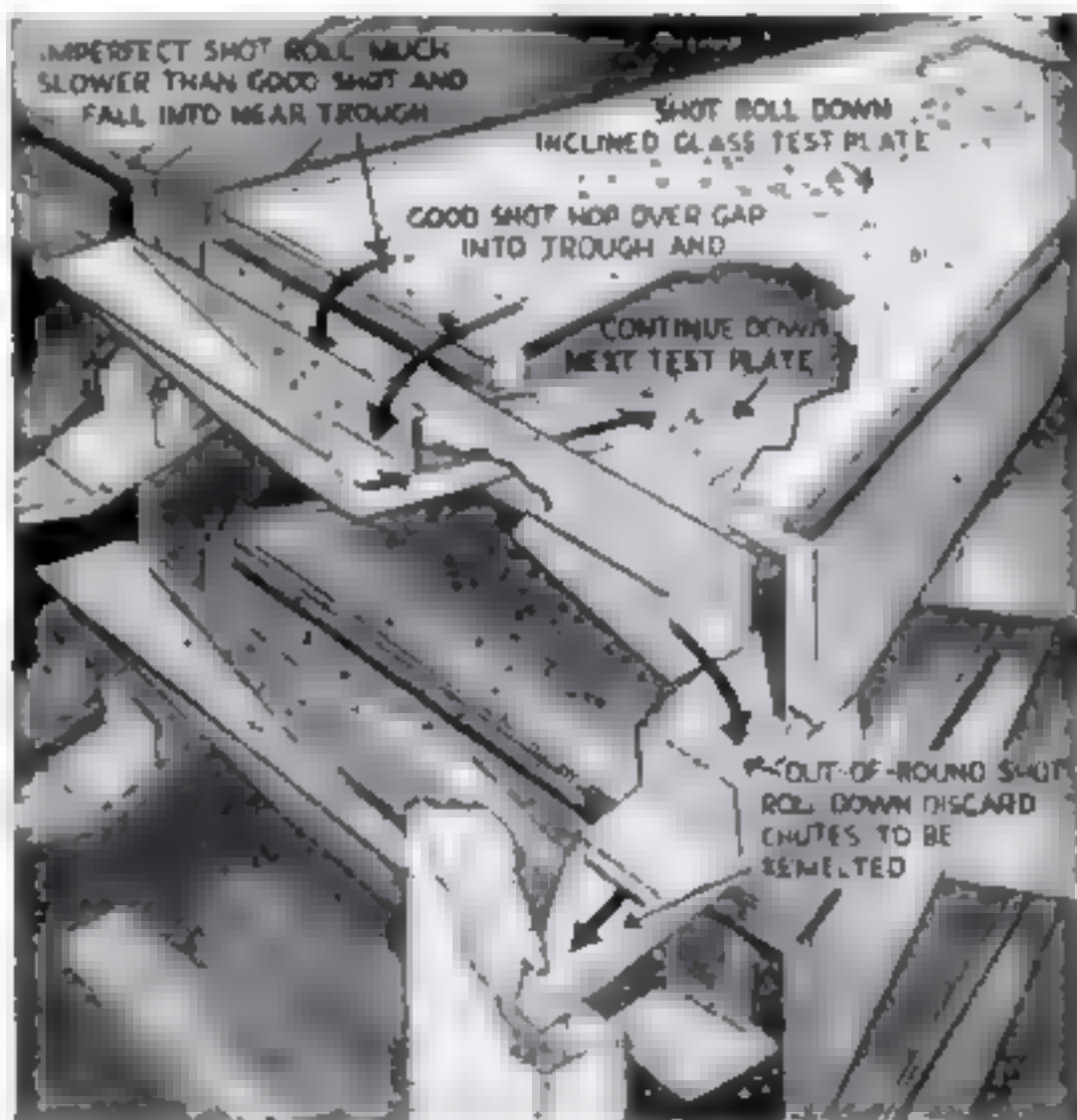


POLISHING is accomplished in an inclined revolving drum containing graphite. A spiral screw inside the drum turns the shot over and over



DELIVERY of the finished shot is shown here as they pour from the last polishing drum to flow by gravity through a series of pipes to the storage tanks. Most of the operations in the making of shot, from dropping until the final inspection, are controlled by gravity

INSPECTION. Culling may be partly manual (as for buckshot) or entirely automatic (for small sizes). At left, below, buckshot roll down a sloping glass table while an operator picks out those that wobble. Drawing at right shows the operation of the strictly automatic gravity device that separates off-shape shot from perfect spheres by making them try to jump a hurdle. There are 13 stages in automatic gravity culling



Haven, Conn., a nine-story tower, especially built and equipped, substitutes for the Natural Bridge. The pellets, which fall into a water tank at ground level, are picked up by buckets on an endless-belt elevator and carried back up the tower, where they begin a series of ingenious sorting and culling operations, all automatic, and done without

any power except the force of gravitation.

The shot tower at the Winchester Repeating Arms Company, a division of the Western Cartridge Company, is 154 feet high, towering above all surrounding buildings. Molten lead, formed into droplets by passing through holes in a dropping pan on the top floor, falls to the first floor, where it is

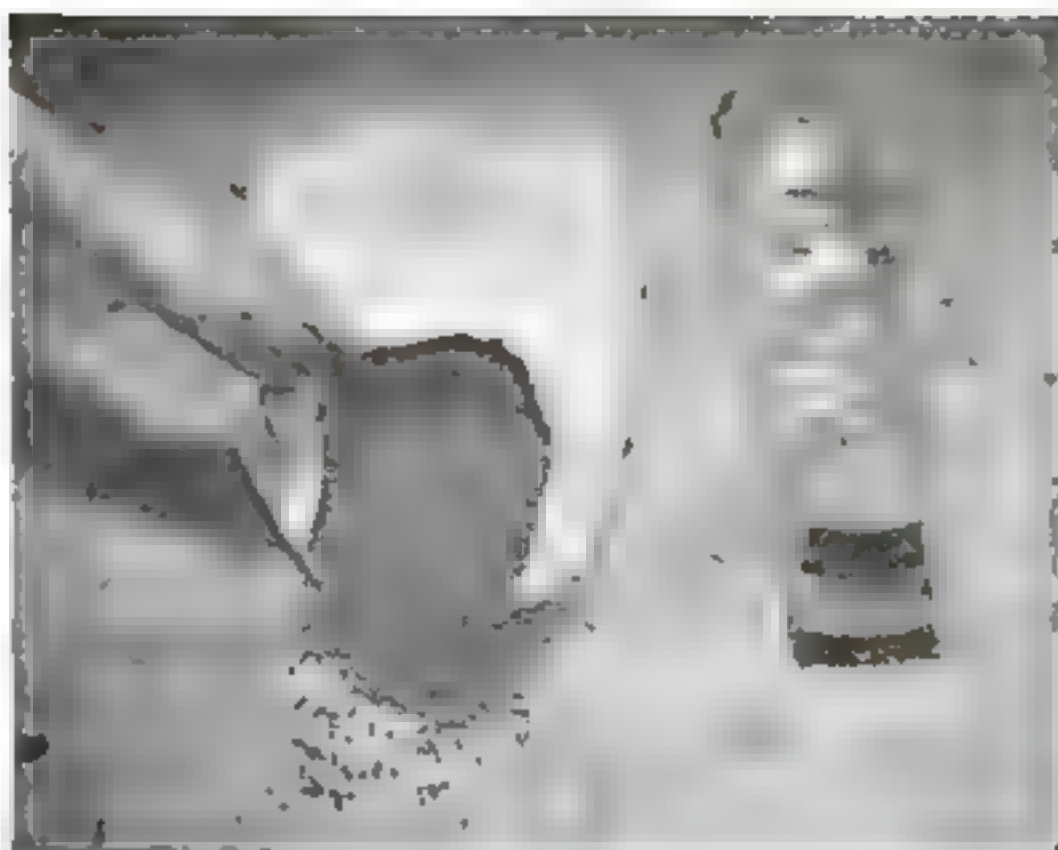
caught in the water. Before they hit the water, the shot are formed into perfect solidified spheres. The fall is sufficient for forming and cooling all ordinary sizes.

If a drop of lead is given a free fall, it is formed into a perfect sphere by a combination of surface tension and air resistance. As the metal passes through the pinholes in the dropping pan, it adheres to the bottom, as water does, until a drop of a certain size has formed, then breaks loose. Therefore the holes in the dropping pan are much smaller than the shot formed by them. For No. 6 shot, the holes in the pan are the size of a fine pencil lead, while the shot are about three times that diameter. The lead adheres to the bottom of the pan for only a fraction of a second, but that is sufficient. For No. 6 shot, an ordinary-sized dropping pan has 2,400 holes. The lead appears to be falling in 2,400 streams, but there are thousands of minute divisions in each stream.

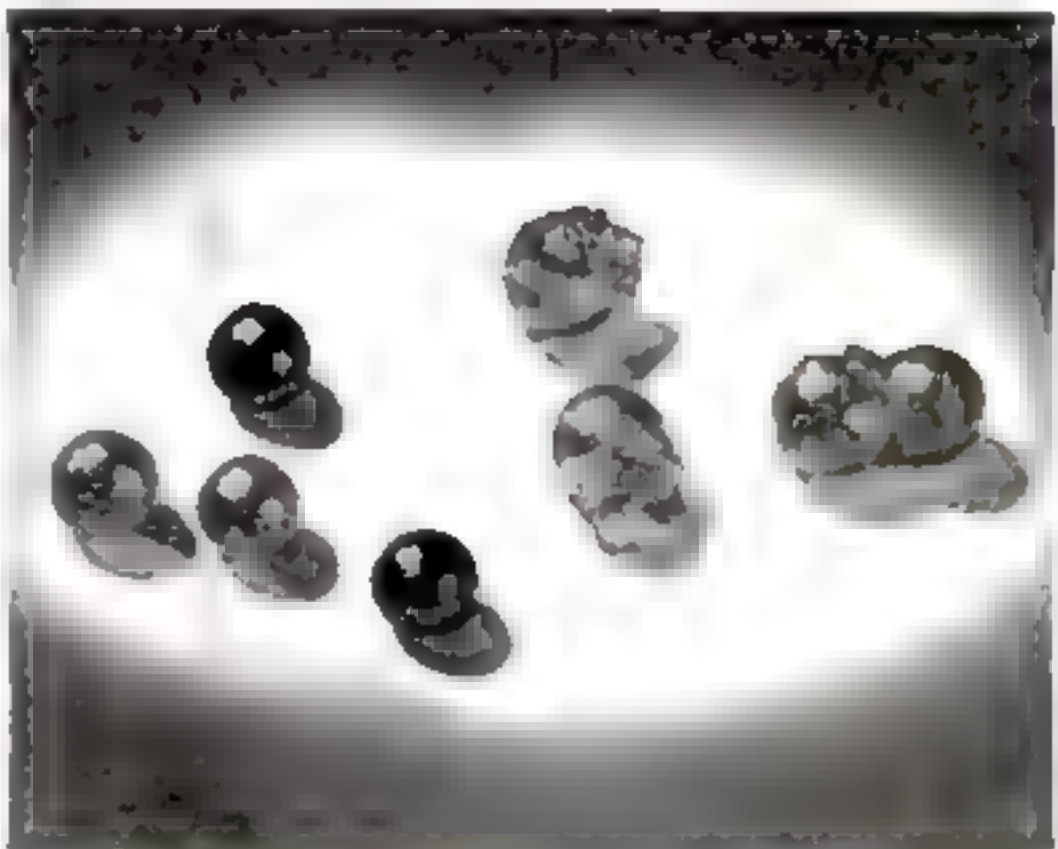
Five tons of lead flows through a dropping pan in one hour. There are 223 No. 6 shot to the ounce; so, as you watch the process, 9,911 pellets of this size pass your line of vision every second. A few seconds later this same lead is being dipped from the bottom of the water tank by scoop elevators.

In modern factories, the inspection and sorting of shot are automatic. The newly made shot are carried upstairs by the continuous-belt bucket elevators, and they run back downward through the various devices by gravity. Several types of imperfections show up, mostly caused by collisions of the droplets before hardening. The odd-shaped shot fall out of the stream as it flows over inclined glass plates leading to two narrow troughs, the first of which receives the rejects. The spherical pellets get up enough speed to jump the cull trap into the second trough and keep going. —GOLD V. SANDERS.

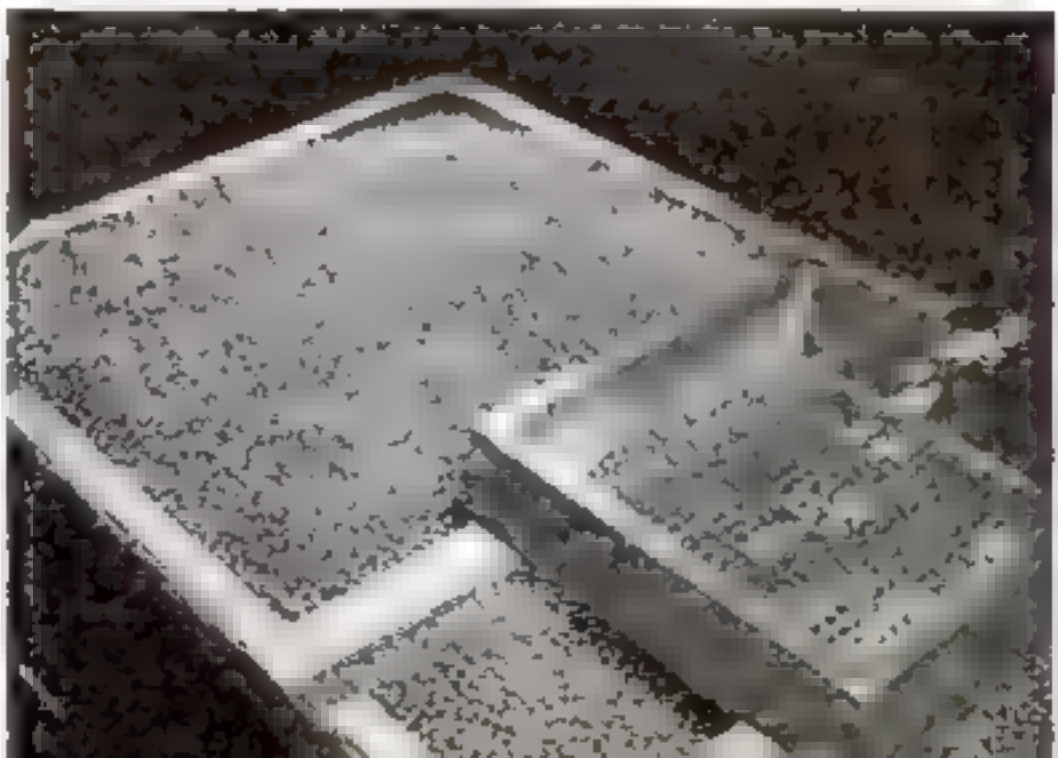
BUCKSHOT flow from the inspection table into a sieve that stops those of irregular shape or oversize that may have escaped other steps in grading. Buckshot are not made by the dropping process, as this would require too high a tower. They are molded, then smoothed and rounded by tumbling and polished with graphite



FINISHED SHOT are packed in comparatively small bags of 100 pounds' capacity. Compare the size with that of 98-pound pig of lead shown at right. Such a bag will hold somewhat more than 350,000 individual No. 6 shotgun pellets



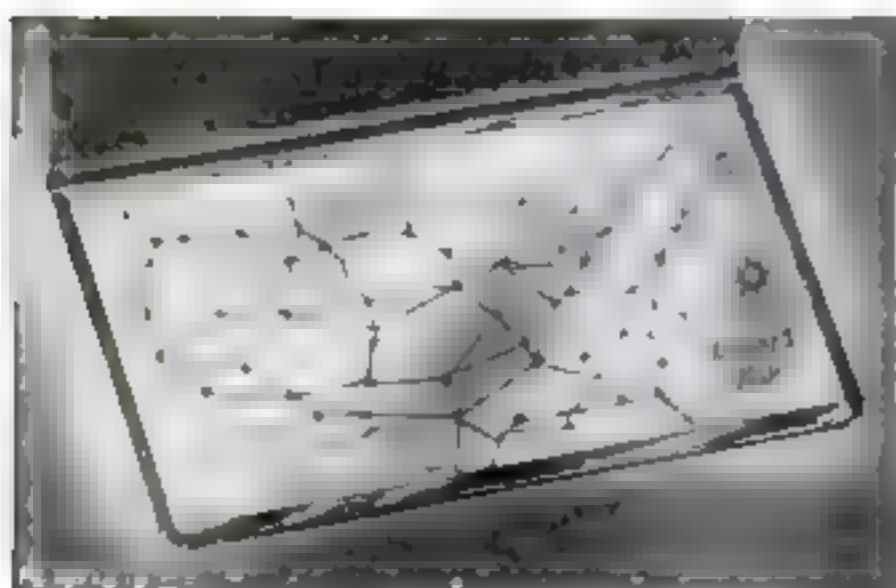
CULLS, shown at the right, are easy for the inspection machine to distinguish from the perfect shot at the left. These malformations are typical examples of rejects, which include many of the Siamese-twins variety. Culls result from collisions in the air before hardening on their way down from the top of the shot tower. They are saved, remelted, and recast





AT ONE BITE, the dipper of the world's biggest power shovel picks up 35 cubic yards (52½ tons) of material, enough to fill a room nine by nine by 12 feet. If set in the middle of a standard city block, the mammoth machine could reach into the

next block and pile dirt on top of a seven-story building 240 feet away. Built by the Marion Steam Shovel Co., Marion, Ohio, the 1,600-ton, electric-powered giant strips overburden off a coal face near Georgetown, Ohio. Hydraulic jacks keep the base level.

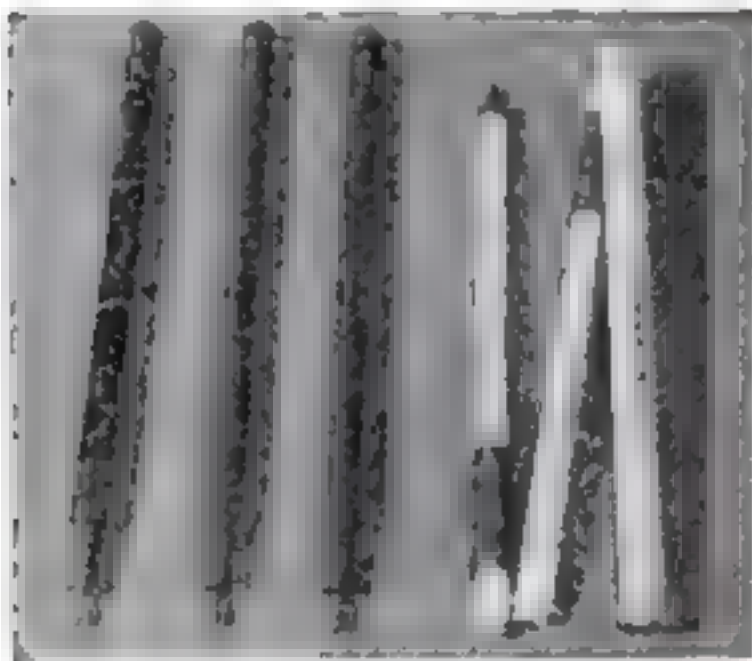


READING MAPS in the dark is made possible by a transparent map envelope that emits a faint glow under near-ultraviolet light. The Lion Manufacturing Co., Chicago, makes the envelopes out of Du Pont Plastacele cellulose acetate plastic incorporating a fluorescent pigment. Markings may be erased and the surface reused.

"FLYING RUNWAY" landing gear, using caterpillar treads instead of wheels, are being tested by the AAF Materiel Command at Wright Field, Ohio, for use on fighter planes to aid take-offs and landings on soft ground. Below, the new type of gear is being fitted on a Curtiss P-40. It has also been tried out on heavier ships.

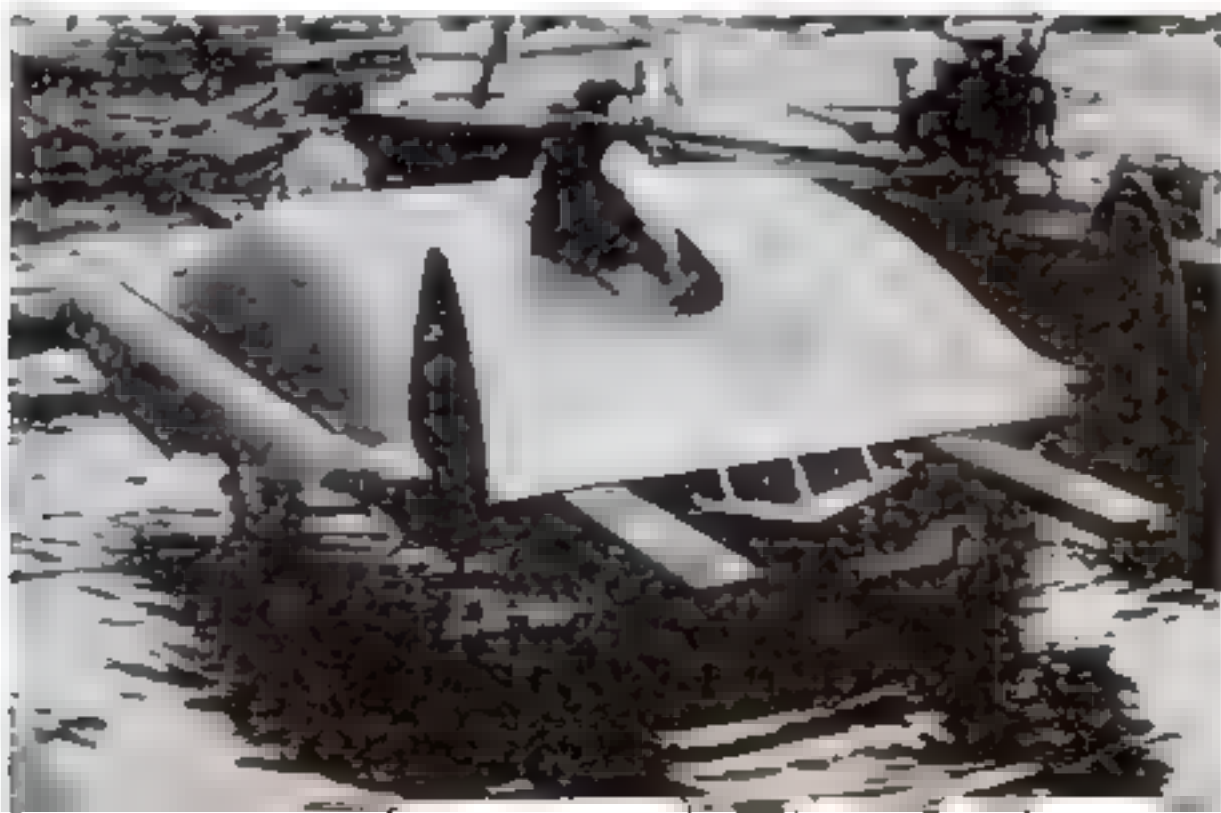


BREAKING THE ICE on navigable rivers and the Great Lakes is the job of this new U. S. Coast Guard ice breaker. Her Diesel-electric power plant, developing 10,000 shaft horsepower to drive two screws aft and one forward, enables her to buck thick ice coverings on the inland waterways to open up channels for shipping. The ship is 290 feet long, 74 feet of beam, and displaces 5,000 tons at 19-foot draft. The bow propeller under the forefoot helps break the ice by sucking the water from under it. Wing heeling tanks, alternately transferring water from side to side, enable the ship to wallow and free herself if frozen in.



A TENT POLE with three interchangeable sections (left) is being issued by the Quartermaster Corps to replace the old three-section jointed shelter-tent pole. Of yellow poplar and Sitka spruce, the new pole weighs less than half a pound.

ARCTIC COLD can't stop the M-7 snow tractor below, built by Allis-Chalmers for Army use at land and air bases in the far north. Thick insulating material covers its hood and body. Hooked to the M-19 snow trailer, it hauls supplies and rescues downed flyers.



AEROBOAT. Speeds as high as 60 knots are said to have been attained by this novel craft designed by Ivan Troeng, Swedish engineer. Driven by a 60-horsepower engine, it is a test model for a proposed 110-ton ship with engines of 3,500 horsepower. Nine tenths of the weight of the boat is supported by air, one tenth by water.



This is about twice as many men as the boat is supposed to carry, but the picture gives you an idea of the rubber craft's buoyancy



Deflated, the boat fits into a pack five by seven feet by 18 inches, and weighs 575 pounds. It is inflated from carbon dioxide cylinders

LARGEST RUBBER LIFEBOAT has been built by The Firestone Tire and Rubber Co. to carry 25 persons plus provisions enough to keep them alive 30 days. The inflated boat is 25 feet long, and has a beam of 10 feet. It consists of a buoyancy tube, 24 inches in diameter, and three inflatable cross tubes that provide seats as well as lateral stability. The space for the occupants measures 21 by six feet. Individual air chambers in the buoyancy tube keep the raft afloat if it is damaged, and a complete repair kit forms a part of the equipment. There is also a removable and inflatable bottom that can be used as an auxiliary raft, since it, too, can support 25 additional passengers in an emergency.



The cross tubes shown provide lateral stability, and bulkheads in the buoyancy tubes insure safety



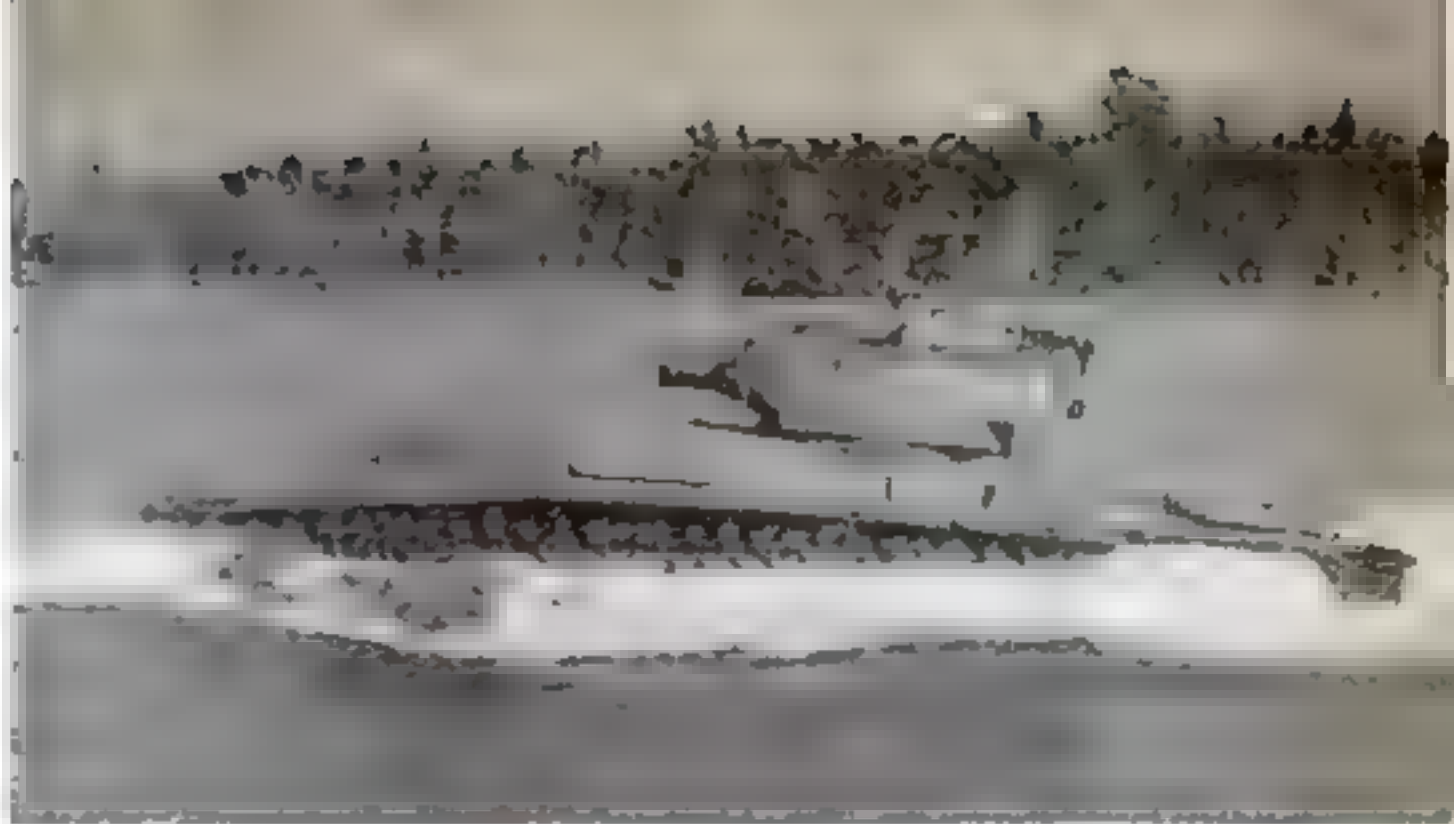
TO CUT A WIDE SWATH at Army Air Force airfields, this 21-foot lawn mower has been developed, and is in use at Scott Field, Ill. Drawn by a high-speed tractor, the mower can cut 18 acres of 10-inch grass an hour. The normal speed of the machine is 10 miles an hour. It was built according to specifications of the War Department by the Worthington (Pa.) Tool Co.

MASKING JIGS of Plexiglas are now used by the Morganite Co., Long Island City, N. Y. in copper-plating carbon rings because of their durability and corrosion resistance, light weight and machineability.

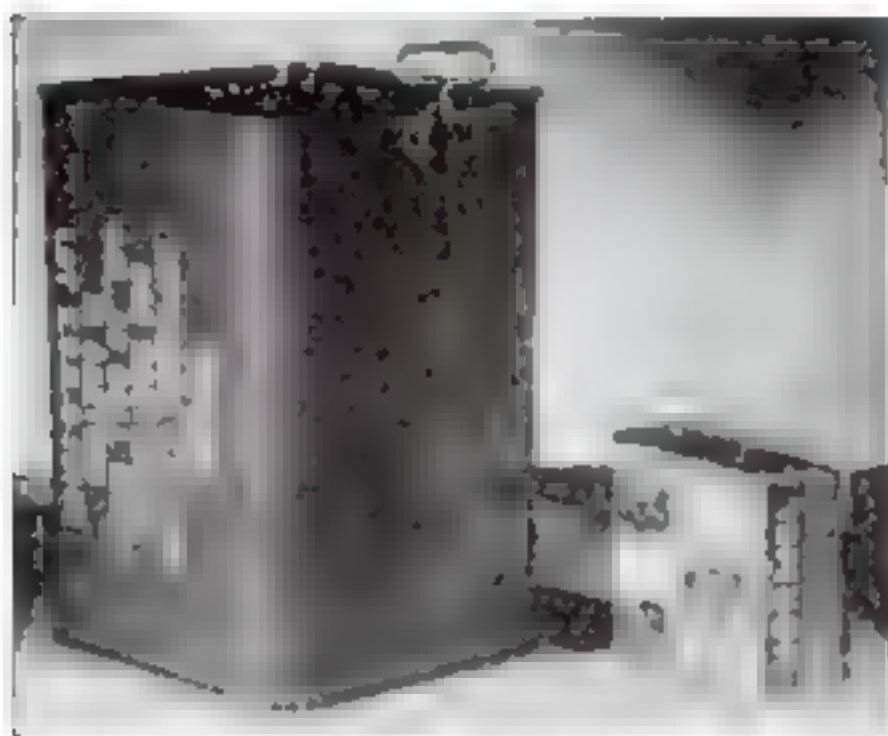


SEAGOING TANK.

Companion of the Navy's amphibian "Alligator" and "Water Buffalo" is the LVT (A)-4, a tracked landing vehicle carrying an armored turret with a 75-mm. howitzer. A similar vehicle, the LVT-4, omits the turret and is armed with machine guns. Fitted with a stern ramp, it carries cargo.



CANNED AMMUNITION. Cartridges made by the Chrysler-operated Evansville (Ind.) Ordnance Plant are packed in hermetically sealed metal cans that open with keys like food containers. About the size of a one-gallon oil container, a can holds 600 rounds of .45 ammunition. Two cans are shipped in a stout wooden box.



CLOCKING the speed of rotating, vibrating, and reciprocating mechanisms is made easy by the "Strobomeca," a spring-driven stroboscopic tachometer. With this new instrument, which is little larger than a baseball, a moving object is viewed through slits in a disk rotating at a speed controlled by the user. When the moving object appears to stand still, its speed is read in revolutions per minute on a dial. Speeds up to 50,000 r.p.m. can be gauged.

FOG FOR COMBAT

is produced by the new M-2 bantam generator. Weighing only 180 pounds when empty, it can be carried by two men, or transported with fuel and crew in a jeep. Yet it puts out half as much fog as the truck or trailer-mounted M-1 (P.S.M., July '43, p. 62). Under favorable wind conditions, it can blot out an area six miles long and 200 yards wide. Automatic in operation, it can be tended by one man.



How Seagoing Shops Clear Captured Ports

Drawing by STEWART ROUSE

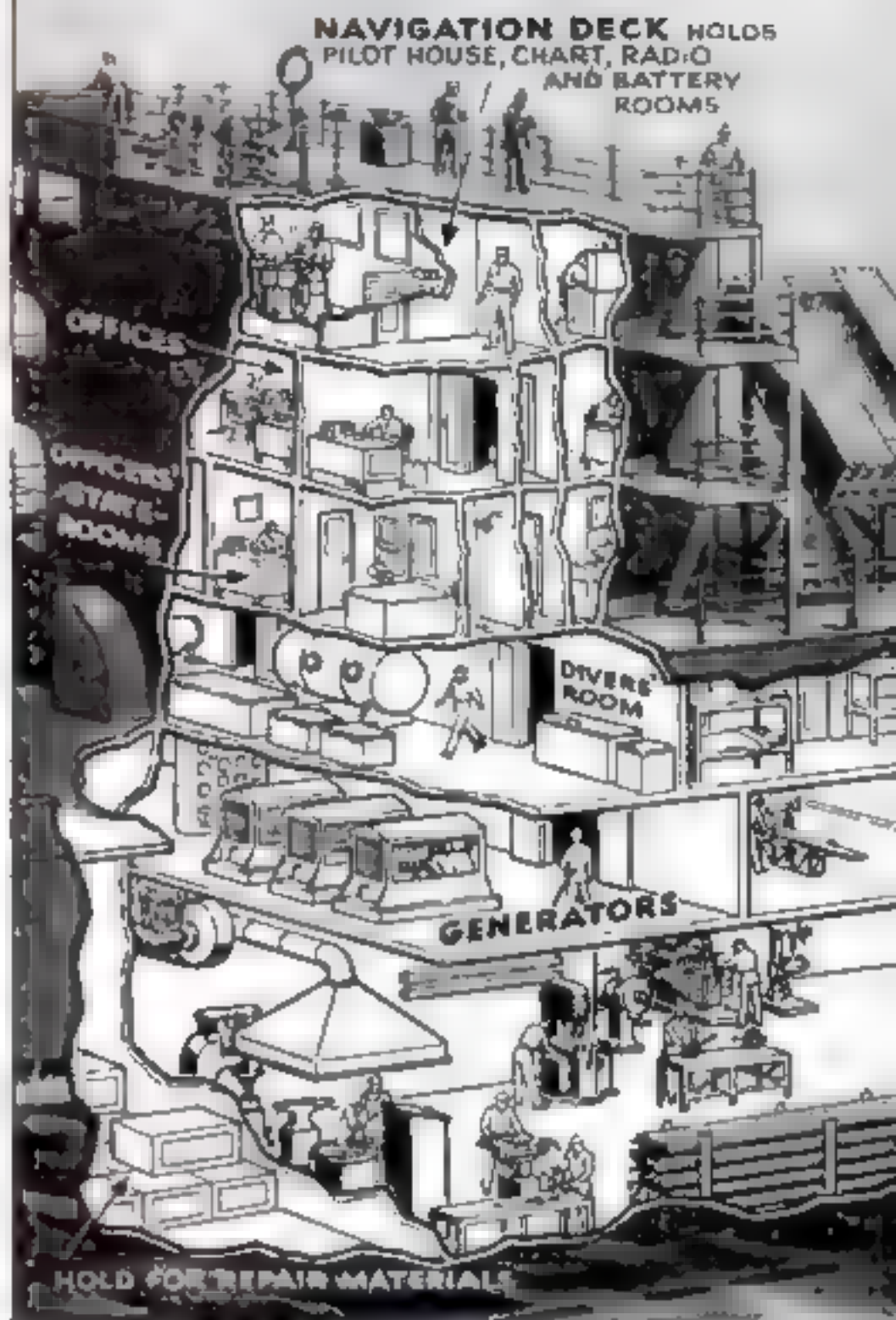
LIGHTNING speed with which Allied forces can start pouring men and supplies through captured ports is due in part to the port repair ship, a new type of vessel developed by the U. S. Army Engineers for the specific purpose of clearing away enemy demolitions and obstructions.

Containing fully equipped carpenter, machine, and blacksmith shops, the port repair ship is ready for any job involved in the restoring of damaged installations. Diving gear and a decompression chamber make short work of raising scuttled ships and removing underwater hazards. High explosives, fire-fighting equipment, and an emergency acetylene lighting system provide for other contingencies.

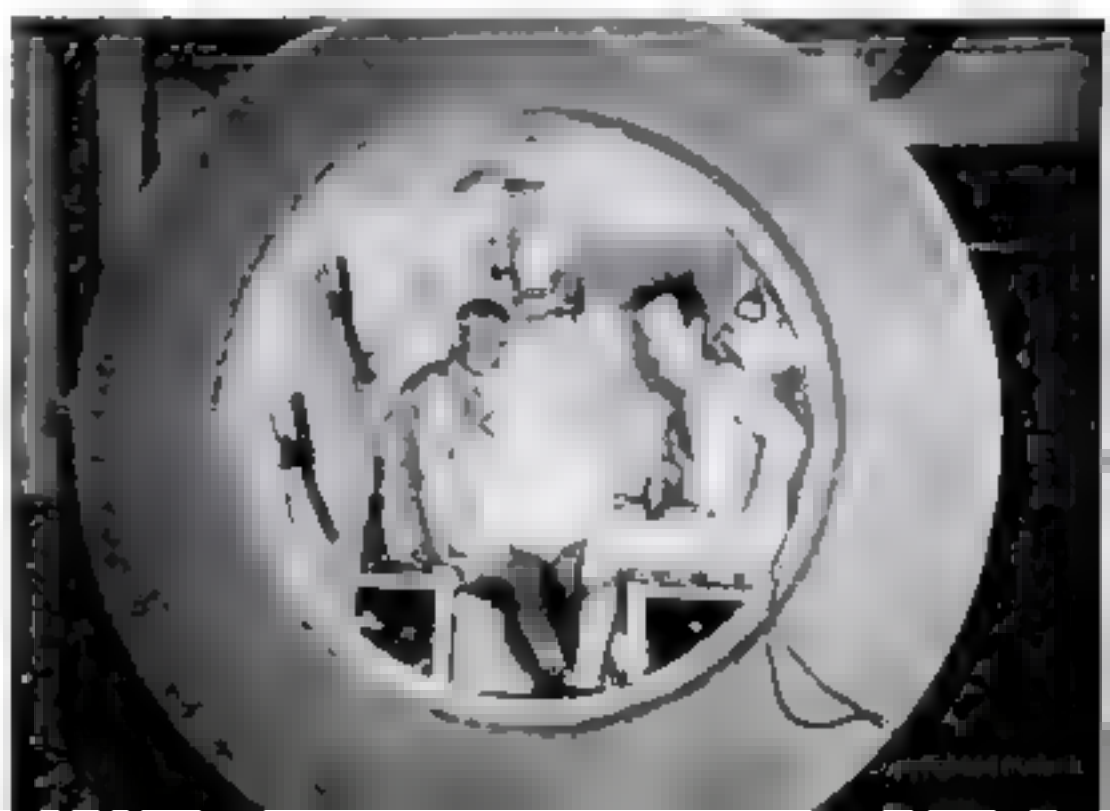
Crews are composed entirely of combat-trained Engineer Corps personnel.

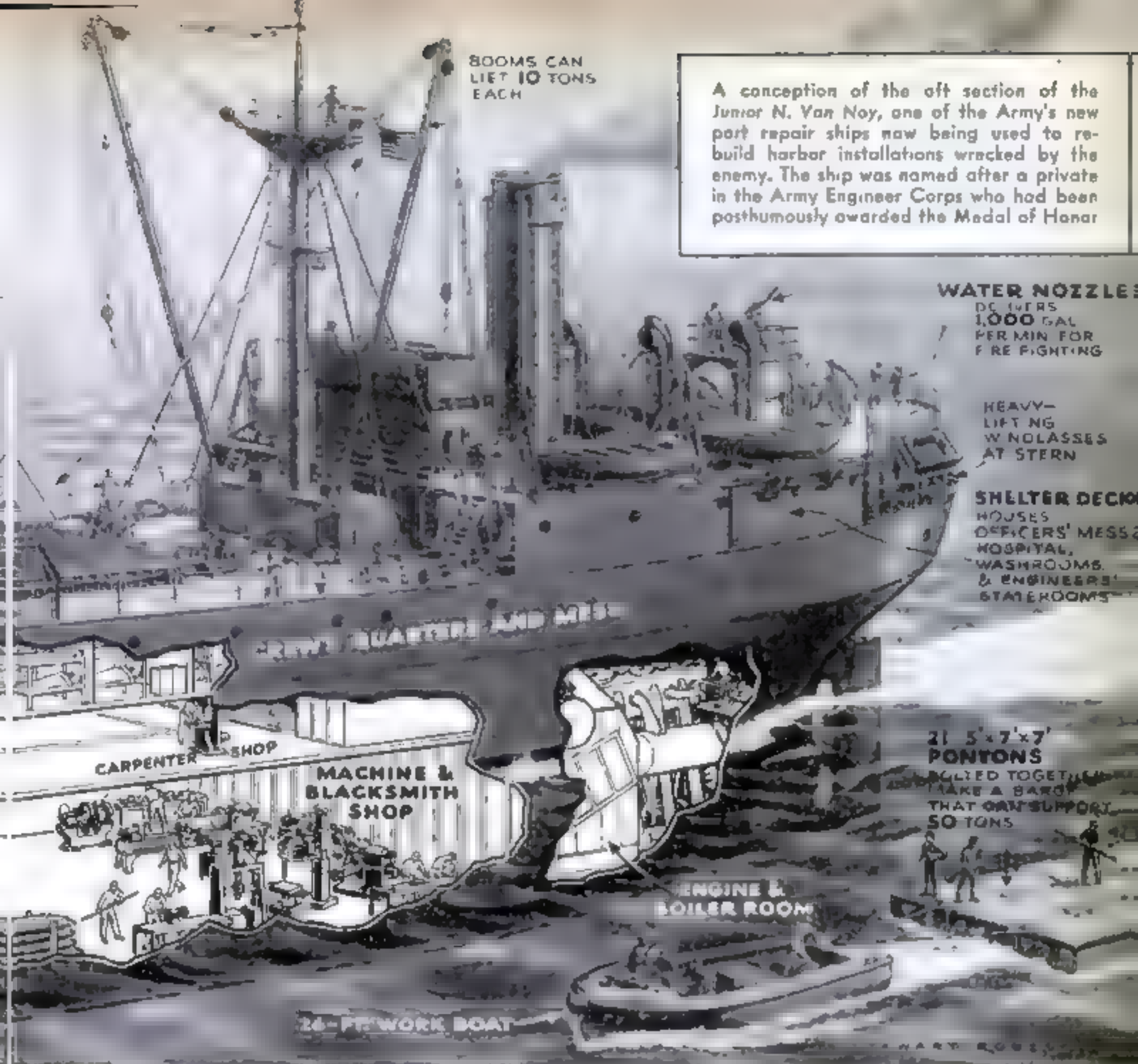
Photographs from Army Public Relations

Important members of the crew are the welders. A concrete slab set in the floor of the shop keeps the heat of the torches from damaging deck plates. Equipment is carried for cutting and welding under water as well as aboard ship and on land. Power for all tools and machinery aboard is generated by auxiliary Diesel engines



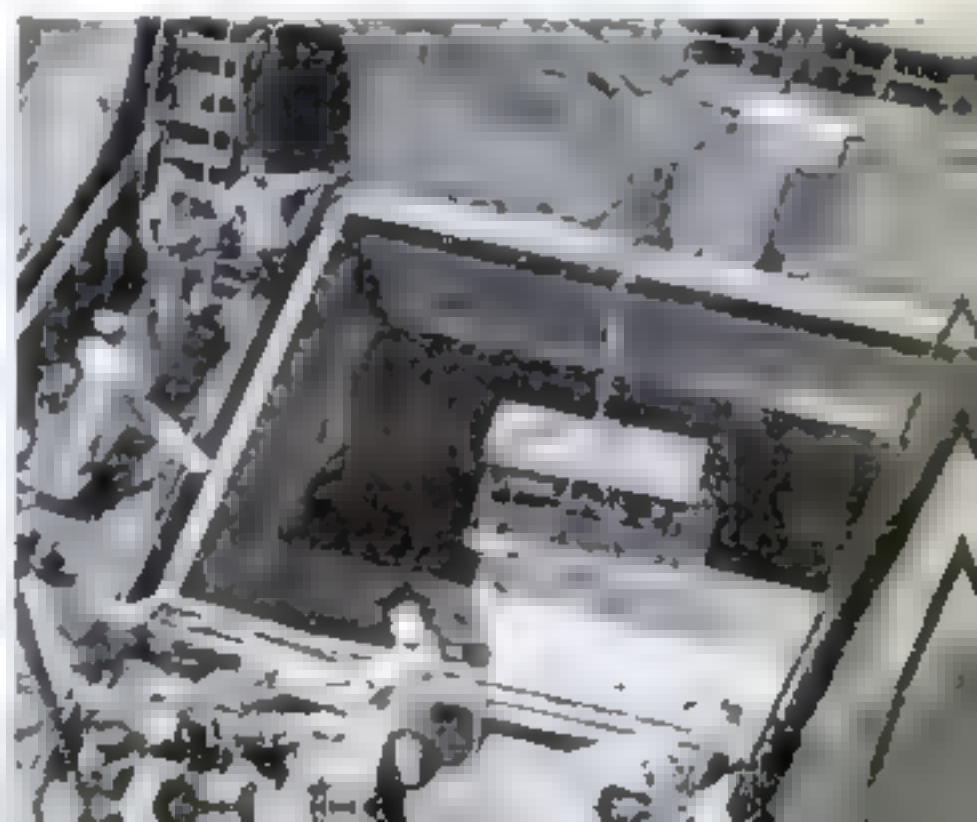
Two of the divers in the ship's decompression chamber. Ordinarily when the men have been working at great depths, they are raised slowly to prevent the excruciating "bends" that result from too abrupt a release from intense pressures. In case of enemy attack, divers can be speedily hauled to the surface, placed in this chamber, and "decompressed" gradually.

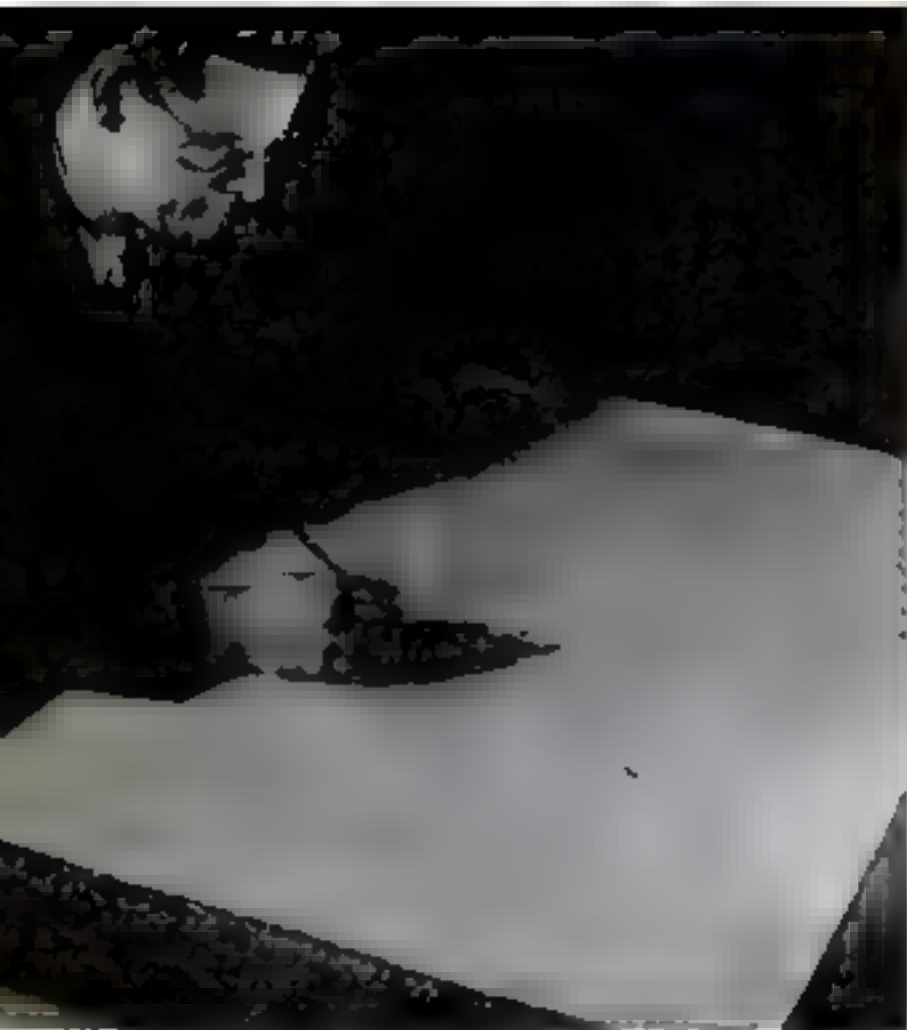




All the necessary equipment, in the latest models, goes to sea in the port repair ship. In the machine shop, work is greatly speeded up by means of a monorail system that is used in conveying heavy parts about the shop. A ventilator system keeps the workers comfortable. Besides being expert mechanics, these men have also been trained for actual combat

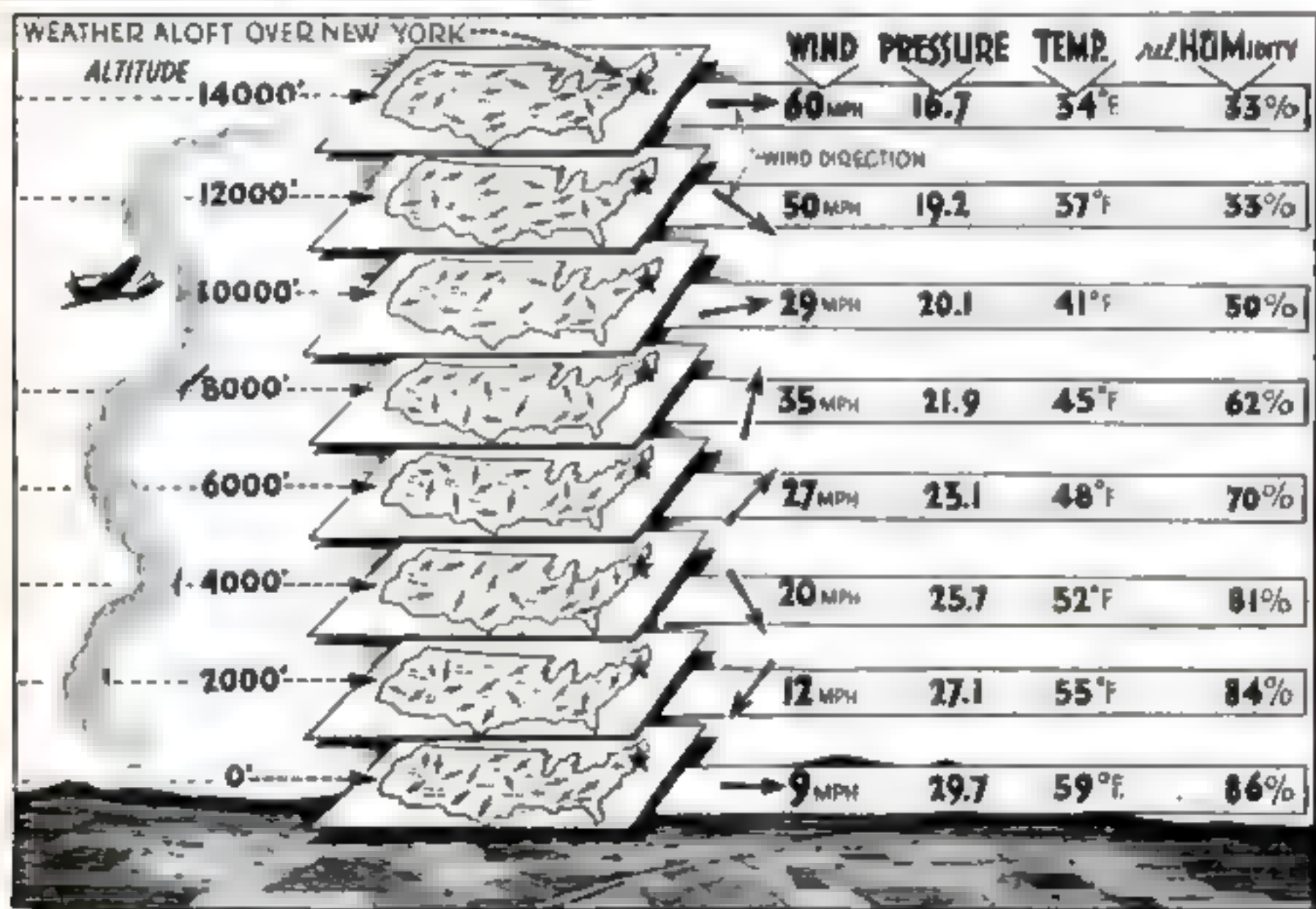
Down the hatch of the Junier N. Van Noy goes one of the portable generators. These can be placed on barges or taken ashore to provide power for tools, lighting, or other work out of reach of the vessel's regular power system. All tools and equipment is of heavy-duty type. Lifting equipment can handle loads ranging up to 50 tons





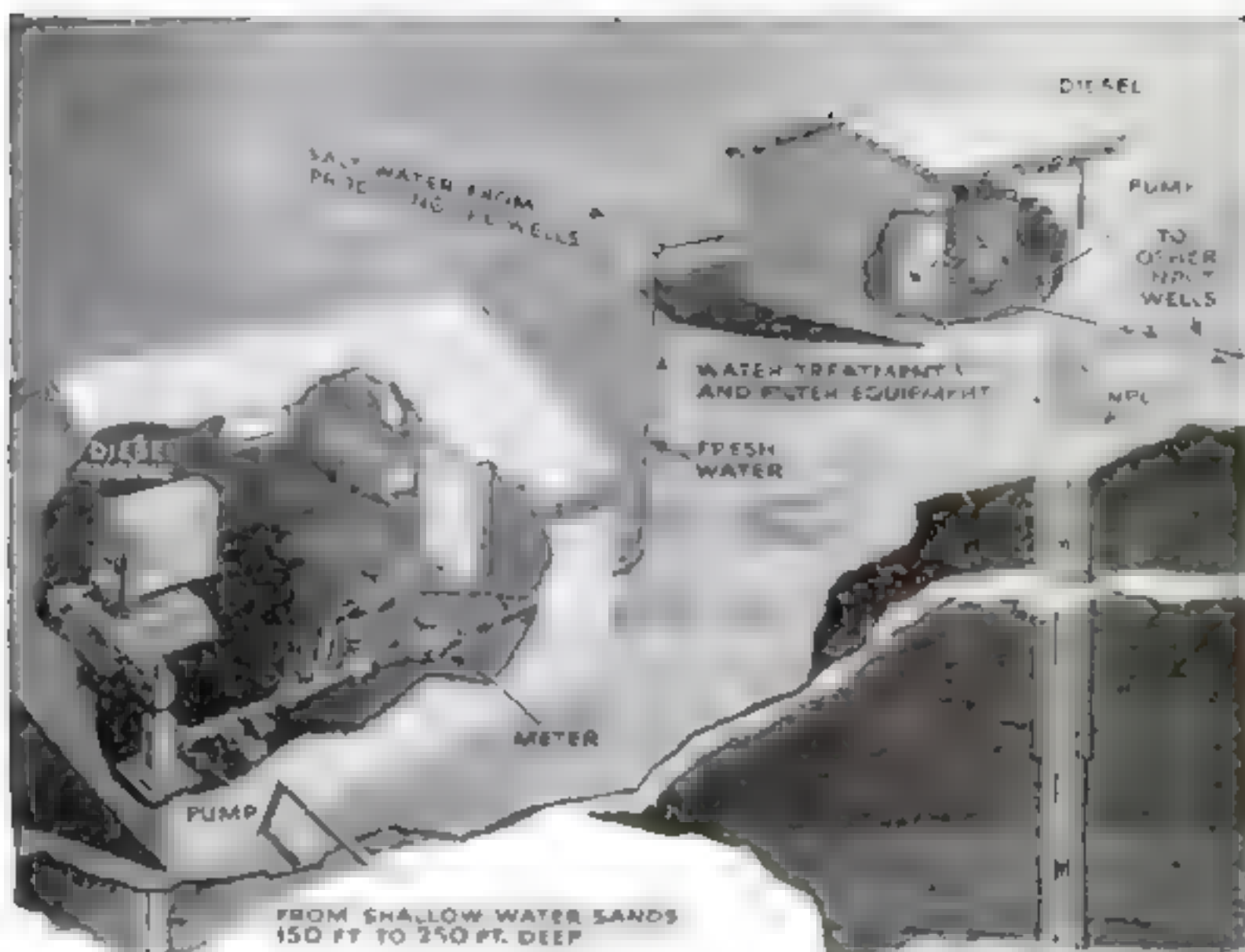
NEW "UPSTAIRS" WEATHER MAPS HELP TO SPEED AIR TRAVEL

MODERN plane travel, with its increasing distances and higher altitudes, has made necessary the upstairs weather map. Prepared four times a day, it shows the temperature, air pressure, relative humidity, and direction and speed of the wind over important flying areas at altitudes ranging up to 14,000 feet. In prewar days, when the average trip per passenger was 367 miles and was flown at comparatively low altitude, a "ground" map was usually a good enough prophecy of the weather plane passengers were likely to encounter along the way, since "weather areas" often extend a thousand miles. Nowadays, instead of trying to fly under, or buck through, a storm, pilots usually fly over it, and then hop from one altitude to another seeking free rides from tail winds.



WATERPROOF MATCHES that will burn in any type of weather are solving a major problem for our G. I. Joes stationed in humid areas. Developed through the co-operation of the match industry with the Quartermaster Corps, these wooden matches, as illustrated at the right, will ignite and burn even after they have been soaked in water. Made only for use by our soldiers, they will be available for civilian distribution after the war.





WATER INJECTION KEEPS OIL WELLS GUSHING AT PEAK PRESSURE

A WATER-INJECTION system that gives oil wells a "shot in the arm" and thus enables them to reattain their original pressure and production rate promises to stretch the nation's dwindling supply as well as reduce the cost per barrel of taking the oil. Reservoirs of oil are not, as popularly supposed, underground lakes, but rather accumulations of oil in porous rock. The force that causes the oil to gush to the surface is generated either by water or gas. As oil is taken from a well, however, this expulsive force gradually decreases, with a consequent reduction in the well's rate of supply. Rather than accept this constantly slackening production, William L. Horner and R. D. Snow, of the Barnsdall Oil Company, Tulsa, Okla., have developed the method illustrated at right, by which water is pumped into the porous rock so as to augment the diminishing pressure. In one of its fields, the Barnsdall Company, by injecting water at the rate of 4,000 barrels a day, was able to maintain a well at peak pressure for a period of several months.

Drawing by B. G. SEIELSTAD



THE ATTITUDE GYRO. For the first time in aviation history, pilots will have an instrument which, while the plane is pitching and rolling, will indicate up to 360 degrees the position of the ship with respect to the earth's surface. Adaptable to all types of planes, the instrument is of most value to those whose missions sometimes require them to engage in acrobatics. Manufacturer is Sperry.

Electronics Brings Magic

OF ALL the miraculous aids to better living that are pouring from electronics laboratories to brighten the postwar era, those which promise to be of the most intimate, personal value to every man and woman are new tools to combat disease and promote health. These tools come as close to pure magic as anything man has dreamed of. They are divided into several classes: Some are magic yardsticks of infinite accuracy that measure the faltering course of human organs — even the brain itself — long before any external symptoms can be noticed. Others are instruments for the immediate treatment of injuries and infirmities...for the prevention of illness...for the long-range study of disease...for the development of the much-discussed new approach to health known as "physical medicine." Carl Dreher describes all these in this, the fourth and last article of his series on electronics in the postwar world.

PART IV OF A SERIES ON ELECTRONICS AFTER THE WAR

By CARL DREHER

THE one major use of electronics which has received the least publicity, and about which the public is consequently least informed, is in public health. Probably the reason for this is that the achievements of electronics in communications, entertainment, and industry have grown to such overpowering stature that they have elbowed everything else out of the picture. Whatever the cause, however, it would not be surprising if, in the long run, it was in the field of public health that electronics proved to be of the greatest importance to mankind.

An inkling of this may have been in Bernard M. Baruch's mind when, earlier this year, he donated \$1,100,000 for research and instruction in physical medicine, meaning external medicine of all kinds as distinct from internal medicine or the administration of drugs. That takes in a great deal of ground, but it is safe to predict that a considerable part of it will be occupied by electronic techniques and appliances. We already know enough about what electronics can do for healthful living to warrant the conclusion that it will do much more in the postwar years.

Before the physician can hope to cure a patient he must know what is wrong with him: diagnosis must precede therapy. Instruments are of paramount importance in scientific diagnosis. They range from the simplest to the most complex. The stethoscope is one of the simpler instruments. In its conventional form, consisting of a

small pickup bell and flexible ear tubes, it is familiar to every layman. The physician uses it to listen to a patient's heart, breathing, and other bodily sounds. It is simply a hearing aid. The fundamental design has changed little in the past 100 years. It will transmit sounds in the band between 200 and 1,500 cycles per second, or three octaves, and it is not "flat," or free from distortion, even within that narrow range. In other words, it is not a particularly good hearing aid—more like an ear trumpet than a product of modern acoustics.

Last year the RCA Laboratories announced an improved stethoscope, flat from 40 to 4,000 cycles, which about spans the fundamental tones of the full piano keyboard. For some purposes this range is excessive. Consequently, a filter controlled by a knob is built into the instrument to select any desired band of frequencies. Although, through long practice, physicians acquire great skill in interpreting the sounds transmitted by the ordinary stethoscope, it stands to reason that better results can be secured with the new wide-range, high-fidelity type.

The high-fidelity stethoscope, like its venerable predecessor, is purely an acoustic instrument, and it may seem out of place in a discussion of medical electronics. The fact is, however, that practically all progress in acoustics since the First World War has been due to the work of electronic engineers, and to all intents and purposes applied acoustics has become another of the

New Aids to Better Living

many branches of the field of electronics.

Like the old-style stethoscope, the 1920 acoustic phonograph transmitted a relatively narrow and distorted band of frequencies. People accepted it because there was nothing better. Around 1924 J. P. Maxfield, of the Bell Telephone Laboratories, designed the orthophonic phonograph, which was a greatly improved acoustic type of reproducer. This was shortly supplanted by the electronic phonograph in use today. Corresponding to the latter, there are electronic stethoscopes incorporating a microphone, vacuum tubes, and a loudspeaker, which may be used for special work where simplicity and lightness are not primary considerations. The RCA device that has been mentioned is essentially an orthophonic stethoscope, the product of electronic principles applied to an acoustic instrument. This is a typical example of the germinal influence of electronics in other technological fields, of which we may be sure we have seen only the beginnings so far.

Such cross-fertilizations are sometimes deliberate and sometimes they just happen, although even then they are scarcely accidental. They are, rather, the logical results of the convergence of knowledge in adjoining technological areas. The May, 1943 issue of the *Bell Laboratories Record* describes a typical case—a novel use of the Western Electric RA-281 sound-frequency analyzer. This electronic-acoustic instrument was designed to sweep over the band from 10 to 10,000 cycles per second in two minutes and to give a complete analysis of sounds picked up in that range. The purpose was the prosaic one of helping to decrease noise and vibration in automobiles, refrigerators, and other machines.

After our entrance into the war, an explosives manufacturer found that employees in one department of his plant were fainting at their work. Fainting in an explosives factory is not only disturbing, but dangerous, since the person who faints may drop a chemical that will

blow up the plant. The physicians who were called in found that the fainting was caused by heart-muscle fatigue, which in turn was the result of inhaling a certain vapor to which the workers were unavoidably exposed. The problem was to detect the condition before fainting occurred.

Examination of the workers' hearts with the ordinary stethoscope gave no results. A more refined method of diagnosis was needed. It then occurred to someone that the RA-281 analyzer could be used on people just as well as on machines. The heart sounds of the employees who had fainted were analyzed and characteristic records were obtained. The rest was merely a matter of periodic examination of all employees with the analyzer. Those who were being

Contributing indirectly to the war against disease, this electronic dehydrator has helped to speed the production of penicillin by shortening a 24-hour bulk-reduction job to 30 minutes. Inventor Dr. G. H. Brown, of RCA, is shown at the machine



affected by the fumes were screened out and transferred to other departments before the critical point was reached. Thus the problem was solved by what was in effect a superior kind of electronic stethoscope, although its use as such could scarcely have occurred to the original designers.

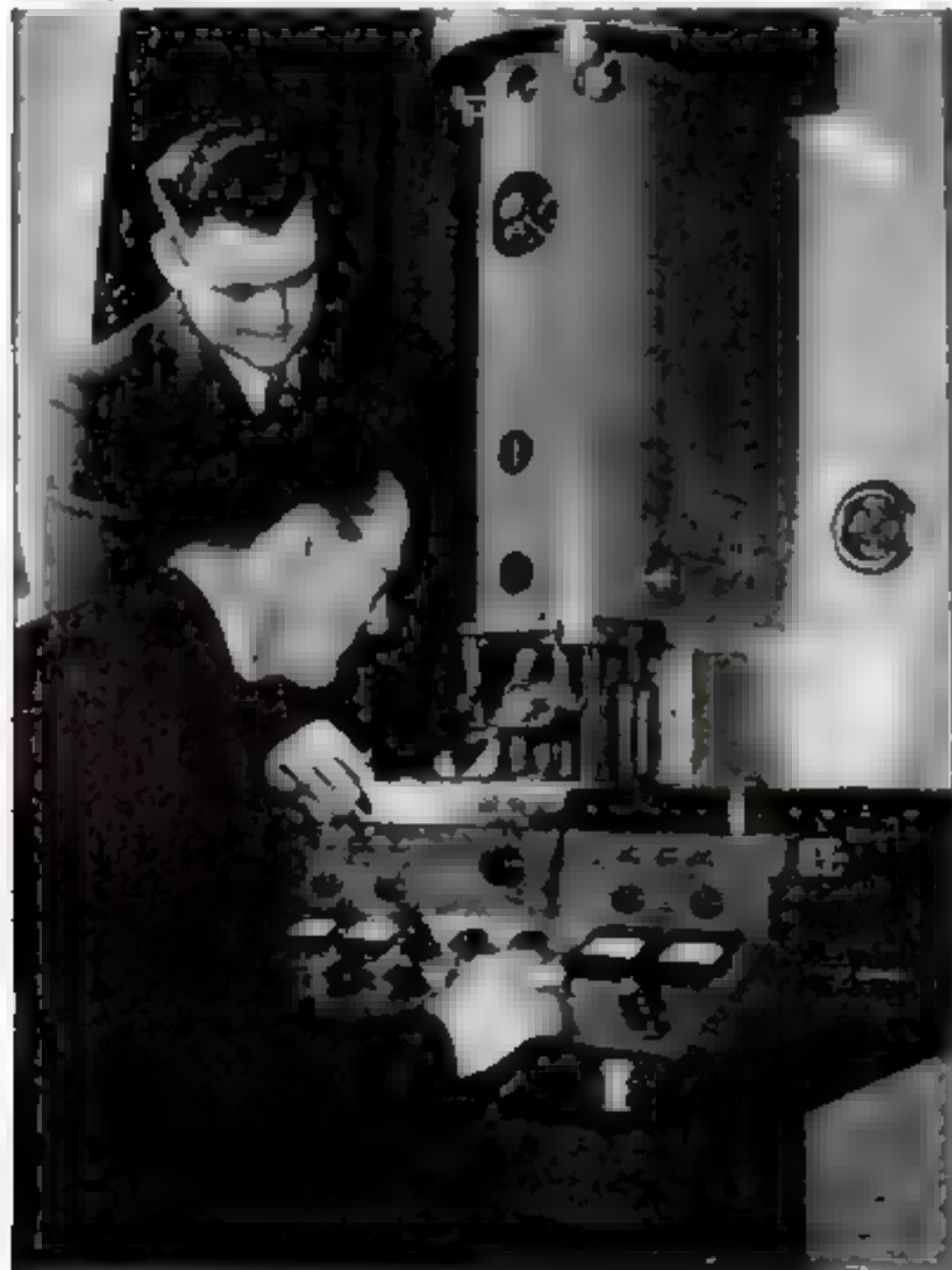
This problem might have been solved, but probably with considerably more expense and trouble, by the use of an electrocardiograph. This complex medical instrument resembles the stethoscope in that it started without benefit of electronics and now leans heavily on the vacuum tube. It was discovered before the Civil War that the heart generates small potentials while beating. Later it was found that "injury potentials" are associated with heart disease. A vast clinical literature arose in connection with the measurement and interpretation of these potentials. Some of it was contradictory and erroneous. Part of the difficulty lay in the limitations of the pre-electronic cardiograph, which was merely a sensitive string galvanometer whose terminals were connected to the patient's arms, or the left leg and one arm. Like the telephone engineers and the designers of motor-control equipment, the doctors needed an amplifier to get intelligible records of potentials whose peaks did not exceed a thousandth of a volt. Like the others, they seized on the vacuum-tube amplifier. The modern electrocardiograph util-

izes several stages of amplification feeding into a mirrortype galvanometer. It is really a vacuum-tube voltmeter, or rather microvoltmeter, such as was mentioned in last month's article, with the addition of amplification and means for recording the readings.

The electrophysiology of an organ like the heart is extremely complex, and progress is largely dependent on the development of sensitive and reliable recording equipment. This requires close collaboration between physicians and engineers who are specialists in their own branches and at the same time know a great deal about each other's work. Many problems remain in this field which electronics will no doubt help to solve. This is true of all phases of what has become known as bio-electricity—the study of electrical effects in living tissue.

The electroencephalograph, which does for the brain what the electrocardiograph does for the heart, has an equally promising future. This brain-potential measuring instrument deals with even lower voltages, down to 10 microvolts, and with frequencies as low as one cycle per second. Special low-frequency amplifiers with a minimum of internal noise are needed to record these potentials. The cathode-ray oscillograph, mentioned in the previous articles in connection with television and industrial measurements, is also a clinical tool for the brain

Photo by RCA



Accessory to the electron microscope (upper part of photo) is an analyzer (lower part) that can identify the atoms in a particle 1/100,000 of an inch in diameter

By filling prescriptions under the germ-killing rays of an ultraviolet lamp, this druggist prevents airborne bacteria from entering his mixtures or their containers

Photo by Westinghouse



surgeon and neurologist. Where a lesser degree of refinement is sufficient, ink-writing oscillographs may prove more practical. Whatever recording means are employed, certain types of slow waves indicate the presence of brain tumors, epilepsy, and other pathological conditions.

The electron microscope is about equally important in industry and medicine. In this instrument electronics has improved on optics. The best optical microscope is capable of magnifying about 2,000 diameters; the electron microscope has already attained a resolving power a hundred times better. What a radical improvement like this means in bacteriology can readily be imagined. The electron microanalyzer, an accessory to the electron microscope which makes possible high-speed chemical analysis of ultramicroscopic bits of matter, such as bacteria, is another clinical tool which is just starting its career in the conquest of disease.

Another instrument at the disposal of the modern physician is the Berman-Moorhead metal locator, or electronic probe, employed by Army surgeons preparatory to removing shrapnel fragments and bullets from the body.

The exploratory and diagnostic uses of the X ray are too well known to require more than passing mention, but X-ray technique is undergoing high-pressure war-time development, the results of which may

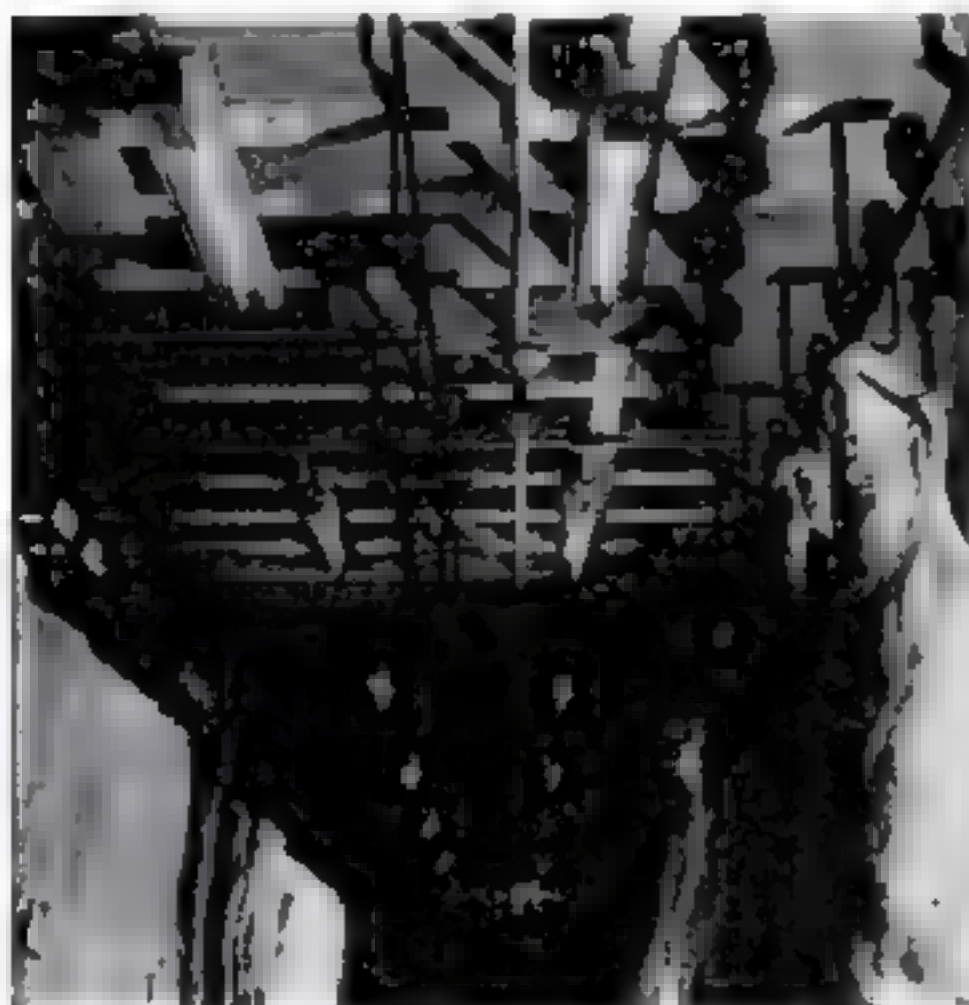
eventually compensate for some of the losses of the war. For example, chest X-rays are now established on a mass-production basis, with a lower unit cost than ever before. The time is not far off when children and adults will have chest X-rays made at regular intervals, just as they now go to a dentist periodically. A few thousand such pictures always uncover a considerable percentage of unsuspected tuberculosis cases, which in the good old days would perhaps have progressed beyond the point where the disease could easily be arrested.

All these instruments mark the transition from crude empirical diagnostic methods to highly scientific techniques, many of which incorporate electronic devices. The full exploitation of these new tools of science will impose new demands on medical education and organization. One way or another, these demands will have to be met, for if rule-of-thumb and hit-and-miss methods are no longer good enough for the factory, they are certainly not good enough for the hospital.

Prophylaxis is concerned with the prevention, therapeutics with the cure, of the diseases that afflict mankind. Electronic methods are not as far advanced in these branches as in diagnosis. One promising field involves the physiological effects of radiation. We already possess considerable knowledge of the effects of radiation of various wave lengths on living tissues, but

At a Westinghouse plant, safety shoes tried on by company workers making a selection are sterilized with ultraviolet rays before returning to stock, to prevent the possible spread of foot infections

In "tenderizing" its beef at its plant in Brooklyn, N. Y., The H. C. Bahack Company makes use of ultraviolet radiation to destroy germs in the air and to prevent mold from accumulating on the meat



there is probably a great deal more that we do not know. Ultraviolet light in the region of 2,537 Angstrom units, for example, is known to kill many harmful species of bacteria. Light of this wave length does not reach the earth in any appreciable quantities from the sun; it is filtered out by the atmosphere. For prophylactic purposes it is generated by mercury-vapor lamps designed for the purpose with glass envelopes which will pass the desired wave length. Such lamps are used for sterilizing the air and exposed surfaces in hospital operating rooms and laboratories. Very likely other wave lengths will be found to have useful properties. In the immense range from infra-red radiation down through the solar rays, ultraviolet rays, X rays, gamma rays, and cosmic rays there may be many electronic frontiers awaiting the onward march

Precipitrons—multiplated electronic machines that snag dirt, smoke, and pollen from the atmosphere—are a vital asset to those war laboratories where clean air is an efficiency factor. The machines also do an effective job in the home. Note the colors of the cats at the bottom of the page. The cleaner one has been living for more than two months in a precipitron-equipped house. The other one hasn't

of medical research toward new discoveries.

Like the X ray, diathermy, or electronic heating, was a recognized medical technique before industry began to exploit its possibilities. The body is not a particularly good conductor, and when heat is applied externally up to a bearable temperature, not much of it reaches the internal organs. It is, however, often desirable to use deep-heat therapy to increase the supply of blood to inflamed or injured tissues. In such cases, as in the parallel industrial situations, the obvious answer is to generate heat within the body rather than to try to make it flow in from the surface. This is readily accomplished by radio- *(Continued on page 817)*



Ozone, valuable as a preservative for storage eggs and as a bleach for testing the color-fastness of dyes, is now being produced from the oxygen in the air with this specially designed ultraviolet lamp

Photos by Westinghouse



How Good Is Your Weather Eye?

Drawings by ERIC SLOANE

FOR centuries, man has been trying to forecast the weather by visible signs. There are dozens of familiar old weather proverbs and saws. How reliable are they?

"Not worth two cents," you may have said to yourself—especially when the day of the picnic turned out rainy after you had predicted fair weather. However, many of them are supported by modern meteorological science.

The sketches on this page show some common "weather signs," with possible interpretations of them. Check whether you think them true or false. Then turn to page 216 to see whether you were right or wrong in each case—and the reason why.



1 Indians planning to go on the warpath used to feel a hanging scalp to see whether the weather would be favorable. This was pure superstition, with no justification in fact. (True or false?)



2 "In the morning, it will be foul weather today, for the sky is red and lowering" Matthew 16:2. (True or false?)



3 When the fluid rises in a barometer or in the body of a Cape Cod weather glass, fair weather's ahead. (True or false?)



4 Swallows fly high when the weather is good, low when a change is about to bring a long spell of rain. (True or false?)



5 If there is dew on the grass in the early morning, it is a sure sign that rain will fall before night. (True or false?)



6 When puffs of cloud seen in the morning become larger and darker, wind and showers are in store. (True or false?)



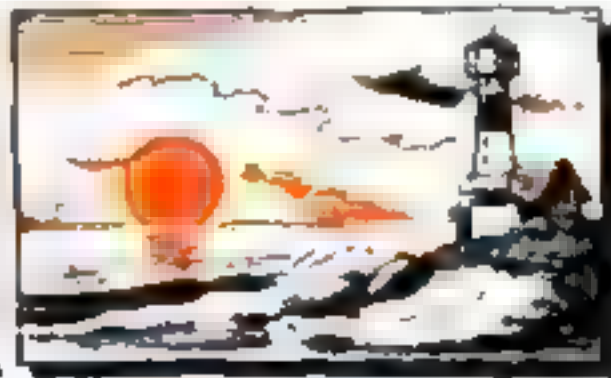
7 Halos around the sun or moon indicate that the weather is clearing and that the next day will be fair. (True or false?)



8 If the weather is fair where you are, and you see a lightning storm far off to the east, you had better run for shelter, because the disturbance is likely to reach you. (True or false?)



9 When the smells from swamps and stagnant waters become more pronounced, and the odors of green vegetation are more noticeable, look for stormy weather. (True or false?)



10 Perhaps the most popular of weather indicators for amateurs is the color of the setting sun. How about this: A red sunset means that it will rain tomorrow. (True or false?)

TURN TO PAGE 216 FOR THE ANSWERS TO THIS QUIZ

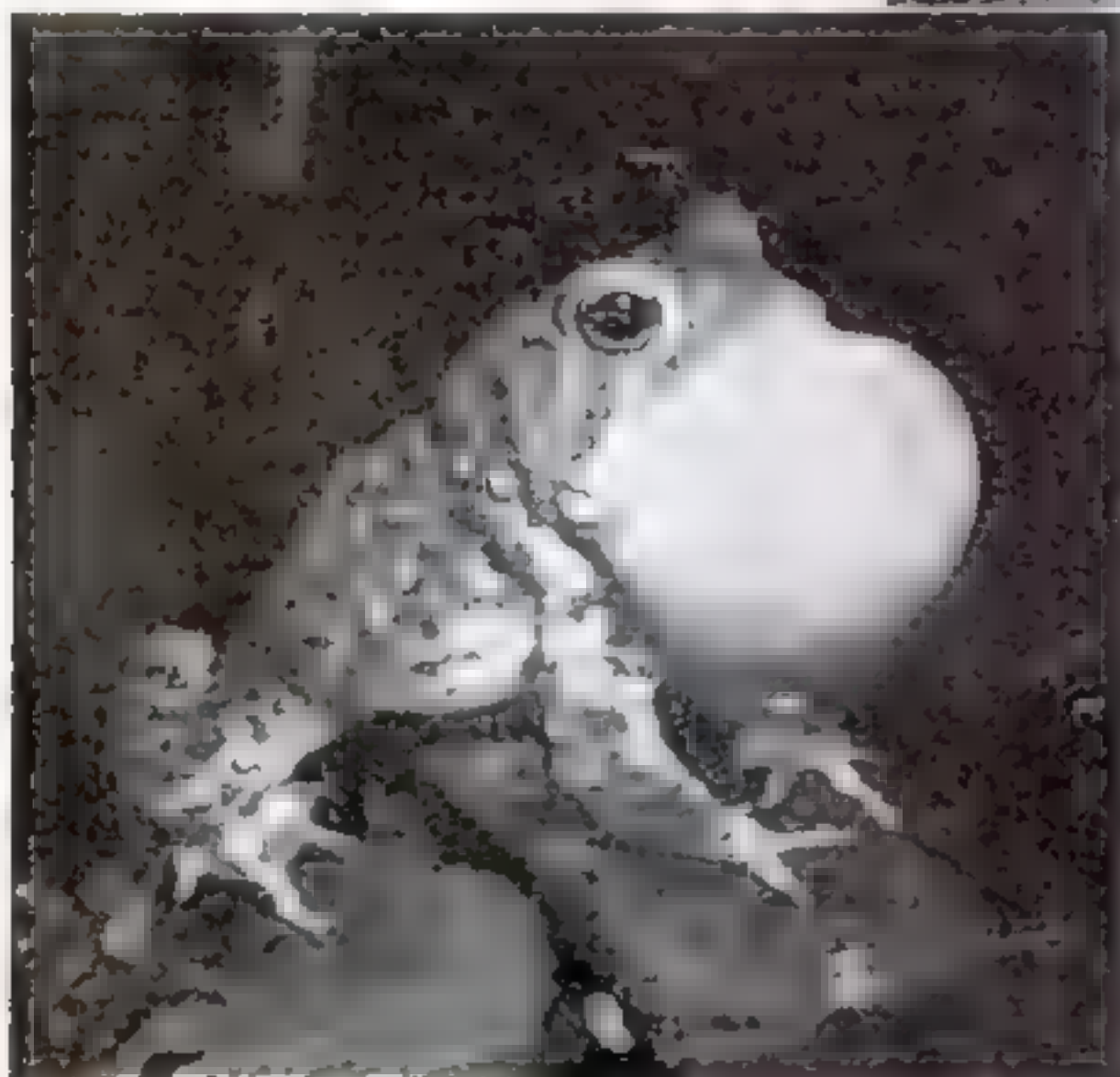
Close-Ups



PEEPING OUT in startled curiosity, the tiny grasshopper sparrow was photographed in its nest in meadow grass by remote control and light from a No. 6 flash bulb. Aperture was f 22; time, 1/250 second



THIS PET CROW posed for its portrait on a low-hanging limb with afternoon sun for a back light and a No. 6 flash directed on the foreground. Aperture f 16; time, 1/150 second



SINGING OUT at the night, a toad was spotted by a flashlight and its attention held while a miniature tripod was set up only 1' away for a synchronized flash at f, 22, 1/250 second

of Nature

GET YOUR CAMERA NEAR FOR UNUSUAL PHOTOS LIKE THESE

By George A. Smith

MOST of our wild creatures are very shy of human beings. Insects, birds, and small animals are rarely accommodating enough to permit a good, clear view by an interested observer. For that very reason, I always try to get clear close-ups when taking nature photographs—close enough views, in fact, to have the subject stand out boldly and characteristically in an 8" by 10" enlargement.

As a rule, I like to get my camera near enough to have my model from nature fill the view finder. This means that the camera must be placed within a few feet of a songbird and within a few inches of a small insect! And that is just the part of nature photography that puts a challenge into getting a good close-up of a wary creature.

For my field work I like a reflex camera because this type enables me to focus up to the moment of releasing the shutter. A reflex camera has another advantage in that with one it is easier to get a low-angle photo, especially when the camera is placed near the ground.

In very close-range work, the least amount of camera vibration will result in a negative that is almost certain to produce a fuzzy enlargement. Therefore, I consider a steady tripod a must for nearly all of my photographs. In taking a picture of a subject that is on or near the ground, I use a miniature tripod. As a matter of fact, I find myself using my 12" miniature in nature photography just about as often as I need my standard-size tripod.

Good lighting is not always to be had where nature subjects are found. For that reason, I always go equipped with synchronized flash when hunting with my camera. I have a swivel-and-clamp attachment and an arm's-length extension cord on the flash gun. With this arrangement it is usually an easy matter to clamp the gun to a near-by support and then adjust it so the flash will be directed into the desired place. If no support is near by, usually a stake can be driven into the ground to support the flash gun.

Another convenient device for catching the more timid wild creatures unawares is a simple homemade affair

for operating the camera by remote control. The accompanying drawing shows the construction of the mechanism, which works on the principle of the lever in operating the cable release.

To use the device, the camera is first set up on a stable tripod at the place selected for the photograph, and a wooden stake is then driven into the ground near enough to the side of the camera for the cable release to reach the lever mechanism. The adjustable clamp is placed on the stake in a position that will enable the cable, when it is attached, to be operated by a mere pull of the string. I use a lightweight fishing line with the device.

When taking a photograph in a tree, I clamp both the stake and the camera to a rigid limb. Occasionally I find it necessary to erect a temporary scaffolding for supporting and securing the equipment. If the remote-control mechanism is mounted independently of the camera, there is less danger of shaking the camera while the photograph

WINGS OUTSPREAD, this newly emerged *Cecropia* moth posed on a japonica bush while gaining strength. Two No. 2 photofloods were used at f/22 and 1 second





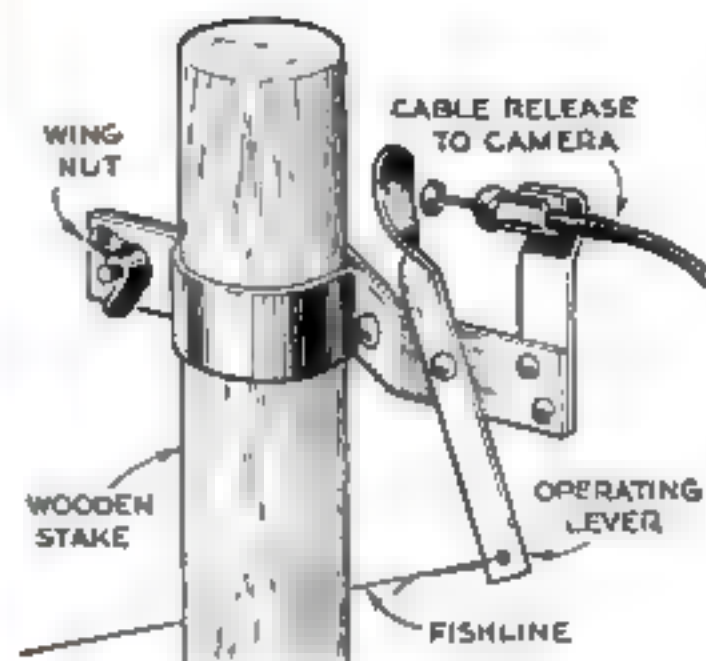
LANDING ON A PEG, this bluebird posed without knowing it. The camera had been focused on the peg in front of its house. Aperture, $f/22$; time, $1/150$ second

is being taken and thus spoiling the picture.

Usually little difficulty is experienced in getting close-ups of insects if advantage is taken of the fact that there is a period of comparative inactivity just after the insect emerges from the pupal stage. Newly emerged specimens also make better models because there is less likelihood that they will have frayed or broken wings.

If it is impossible to get a photograph of a particular insect just after it emerges, I often resort to a cooling-down technique. In this procedure, the insect is placed in a refrigerator until it is chilled to an inactive state. It is then quickly placed in a

COILED LAZILY in the bright sunlight, this caged black snake was photographed with two No. 2 photofloods to aid illumination. Shutter at $f/11$; time, $1/150$ second



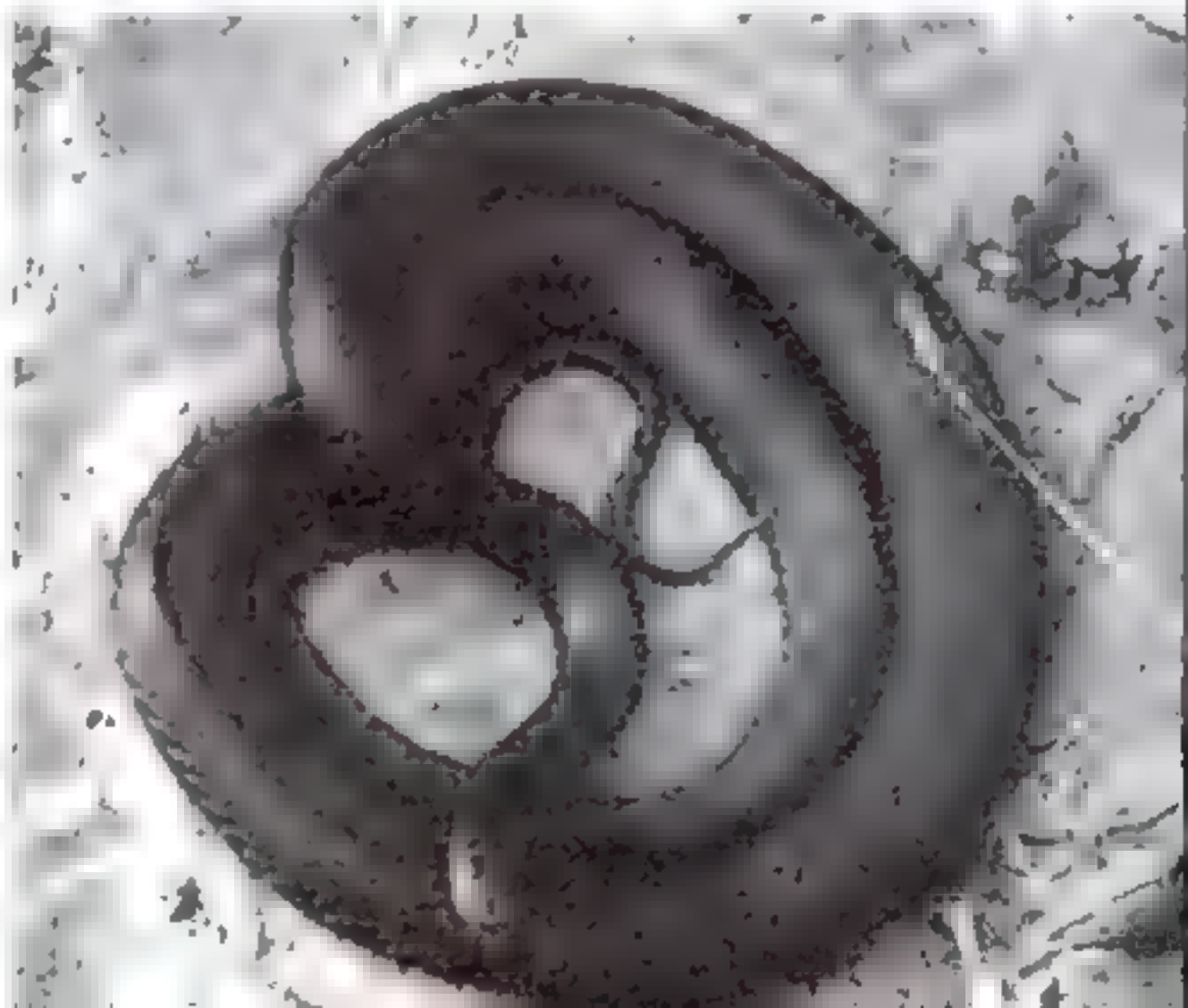
Remote control of the camera shutter is possible with a lever set on a stake and attached to the cable release and a cord

prepared environment and photographed just as soon as it warms up sufficiently to strike an alert pose. Often several good exposures can be obtained before the insect gains sufficient strength to fly away. The accompanying photo of the crane fly was made with this cooling-down technique.

I get most of my bird photographs around feeding stations or at nesting sites. During the nesting season maternal instinct is frequently so strong that a bird will continue to feed its young while the photographer approaches to

within a few feet. The brown thrasher will usually fly right into its nest to protect its young when anyone comes within close range.

When photographing the more timid birds, I use the remote-control method of releasing



the shutter. For this, my camera is set up and focused on the nest, and a long cord is led away from the lever device. When the bird comes to its nest, the cord is pulled and the photograph is taken.

In getting the photograph on page 142 of the grasshopper sparrow peeping out of its nest, I used both synchronized flash and remote control. This was a completely blind exposure, for I was unable to get even a glimpse of this timid little bird as I pulled the cord from a concealed position more than 100' away. After setting up the camera, I had to wait patiently until the bird approached its nest and then wait again for a short while until I thought it had had sufficient time to settle down. The look of startled curiosity I was able to capture was well worth the trouble I went to.

In preparing to photograph some small subjects, such as frogs, turtles, and snakes, I catch them alive and keep them in captivity for a few days. At the end of a period of acclimatization, I photograph them in an



DAZED BY COLD from a stay in a refrigerator, the crane fly was put on a blade of grass and taken as it warmed up enough to look natural. Aperture, $f/11$; time, 2 seconds

open-top enclosure. In this enclosure, which is approximately 4' by 6' in area and about 3' high, I arrange natural surroundings of grass and stones and also set up the camera and miniature tripod for close-ups. With an

open-top enclosure, I find it convenient to stand on the outside and bend over while focusing the camera and snapping the shutter release, since in this way I can get very close to the subject.

Naturally, this procedure would be entirely too unsafe for photographing poisonous snakes or any very aggressive animal. The black snake shown in one of the pictures on the facing page, although not of the poisonous type, was photographed in a wire enclosure. I coaxed it into position by gently nudging it with my hand. If you are uncertain whether or not a particular snake is harmless, or if you distrust all snakes, it is just as well to use a wire enclosure for them at all times. And it may be wise, too, to prod them into position with a stick from a safe distance.

Regardless of the method I use in getting nature photographs, however, I always plan every detail carefully as far in advance as possible. In this way I am ready to make the exposure as soon as the subject assumes a pose that embodies natural action and excitement. If you follow the same practice and employ a little patience, once you have learned something of the habits of these little wild creatures, you will find you are rarely, if ever, disappointed.



THREE CATBIRD EGGS were photographed in this nest hidden in shrubbery. Synchronized flash put light in the dark corner. The shutter was at $f/22$; time, $1/150$ second

CAN YOU BEAT THESE PICTURES?

We will pay \$5 for any photo used on this page. Write your name and address on each print. Enclose a stamped, self-addressed envelope and the negative, if it is available, and send your contribution to the Curious Photos Editor.



THIS TINY BIT OF FUZZ with the amphibious landing gear is "Rocket", a duckling that was born in a rectifier. A repairman placed an egg in the device, which is used to charge batteries in a Rock Island Railroad office, and 28 days later out stepped Rocket.

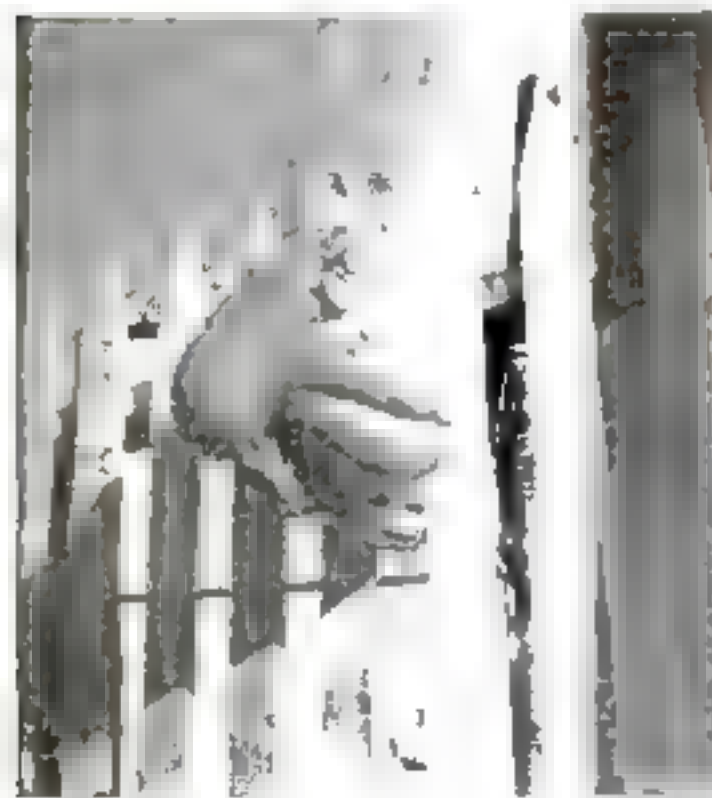
PICKET FENCES do not a prison make. The squash shown below grew in—or rather half in and half out of—the garden of G. Fales Peirce, of Rumford, R. I. He says that despite its peculiar existence it ended up prosaically enough in a good squash pie.

NOSE-DIVING off a 20-foot embankment, the automobile at the right landed and balanced on its radiator. Three people who were in the car at the time escaped with only scratches. The accident took place at Mullin, Idaho, and D.C. Scarborough, of Tucson, Arizona, contributed the picture.

TRAINMEN passing through Noyes, Minn., needed a home during layovers, so they built the house shown below and then ingeniously decorated it with engine parts.



TWO DISTINCT HEADS, each fully developed, were possessed by this king snake that was found and killed by a Pennsylvania woman. Photo by George A. Smith.



How to Restore Discolored Lenses

DISCOLORATION of a multiple lens can usually be traced to the cement, which because of age or condition of use may turn yellow, crackle, or become opaque. The average craftsman will not find it difficult to restore such a lens, or to cement elements obtained from salvaged lenses.

Remove the lens from its mount, running the point of a knife under the rim, if necessary, to spread it. Like most two-lens achromatic combinations, the 16-mm. projector unit shown in the photos had a concave and a convex element. They had become separated, so the old cement, which was Canada balsam, was washed off with xylol (xylene), a common balsam solvent. Lacquer thinner, waxless paint remover, and some dry-cleaning fluids work as well. Unseparated lenses may be soaked in solvent or heated to soften the balsam.

The elements were next cleaned with a commercial lens cleaner. If soap and water are used, avoid strong soaps. Distilled or rain water is preferable to tap water.

Balsam for cementing lenses usually comes in stick form and must be crumbled and heated to about 300 deg. F. along with the lens elements. A small electric furnace with heat control is ideal (see P.S.M., Nov. 1943, p. HW 554), but a glass or iron frying pan will serve. Heat slowly and uniformly and avoid sudden chilling. If optical balsam is not available, liquid balsam used in making microscope slides can be heated to drive off the solvent. When cool it will be brittle and can be used for cementing lenses.

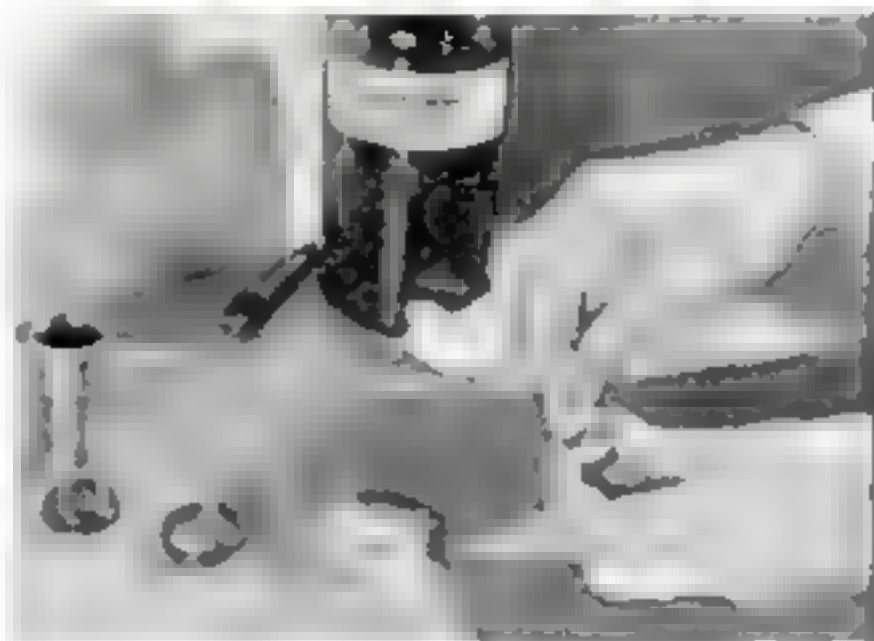
Dust the lenses carefully with a soft brush, and try them, if they have not been marked, to match the surfaces. Usually matching surfaces create a slight suction when separated. Lay the lenses on window glass if a furnace or iron skillet is used. Have the concave side of the negative lens up and the matching surface of the positive lens down. You can handle them with photographers' wooden or bamboo print tongs.

Put balsam on the concave lens—about a $\frac{1}{4}$ " rounded pile on a 1" diameter lens—and heat gradually until the balsam melts and flattens out into a single puddle. If you can control the temperature, keep it under 350 deg. F.

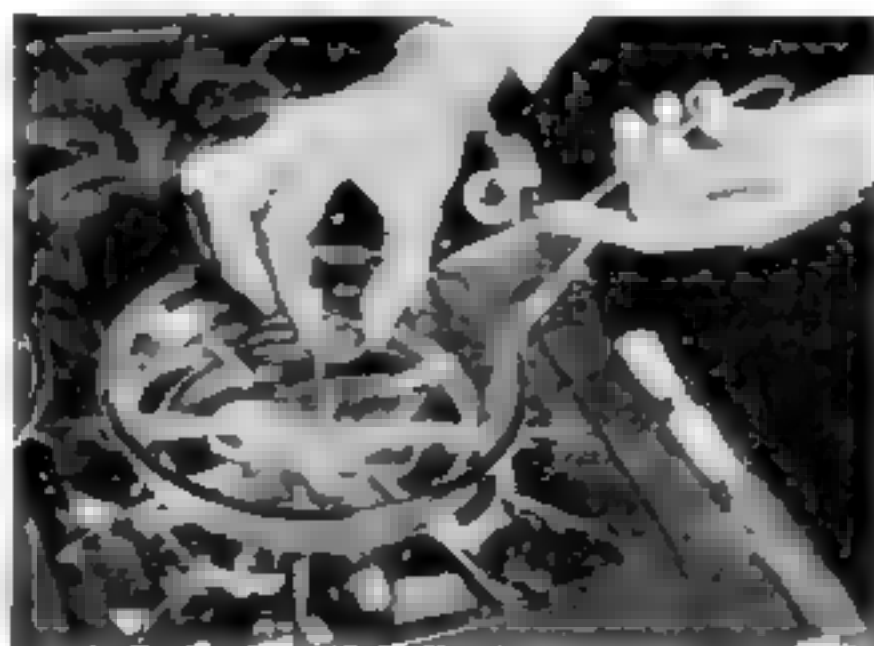
Lift the convex lens and place it squarely over the concave one, press down to spread the balsam, and slide the upper lens in various directions to get rid of trapped bubbles; then center the lenses so the edges match all around, and press out all excess balsam. Let them cool slowly in the skillet or furnace with the lid in place. Scrape excess balsam from the edges, wash the surfaces with



When lens elements are being taken out of their mount, the rim may need spreading to release them



Old cement is removed with xylol or some other solvent (above), and the elements are cleaned, matched, and heated, with balsam melted on the concave lens, shown held in the fingers below



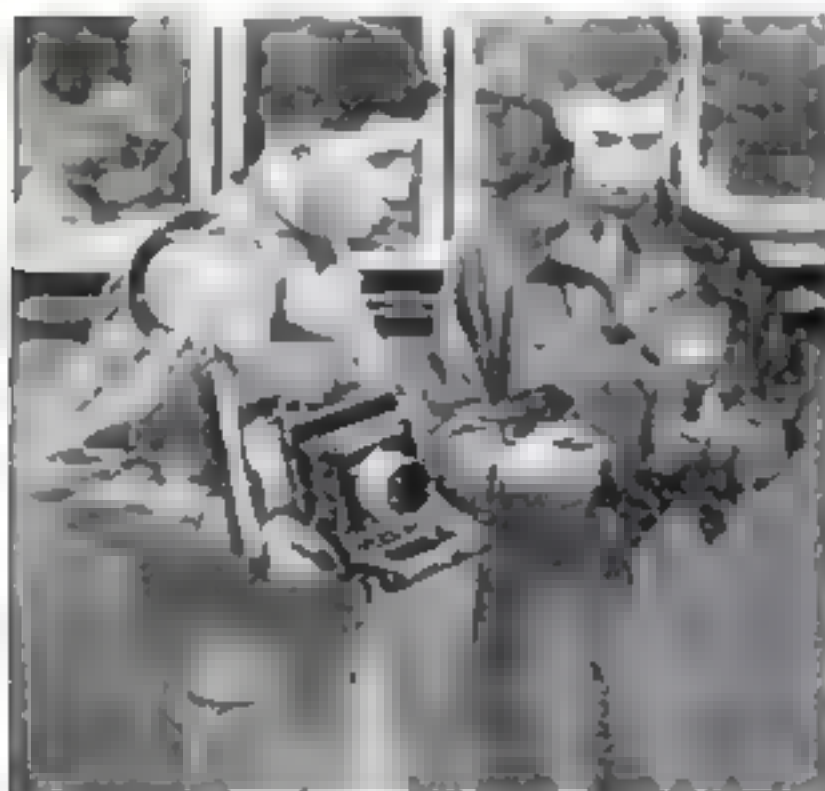
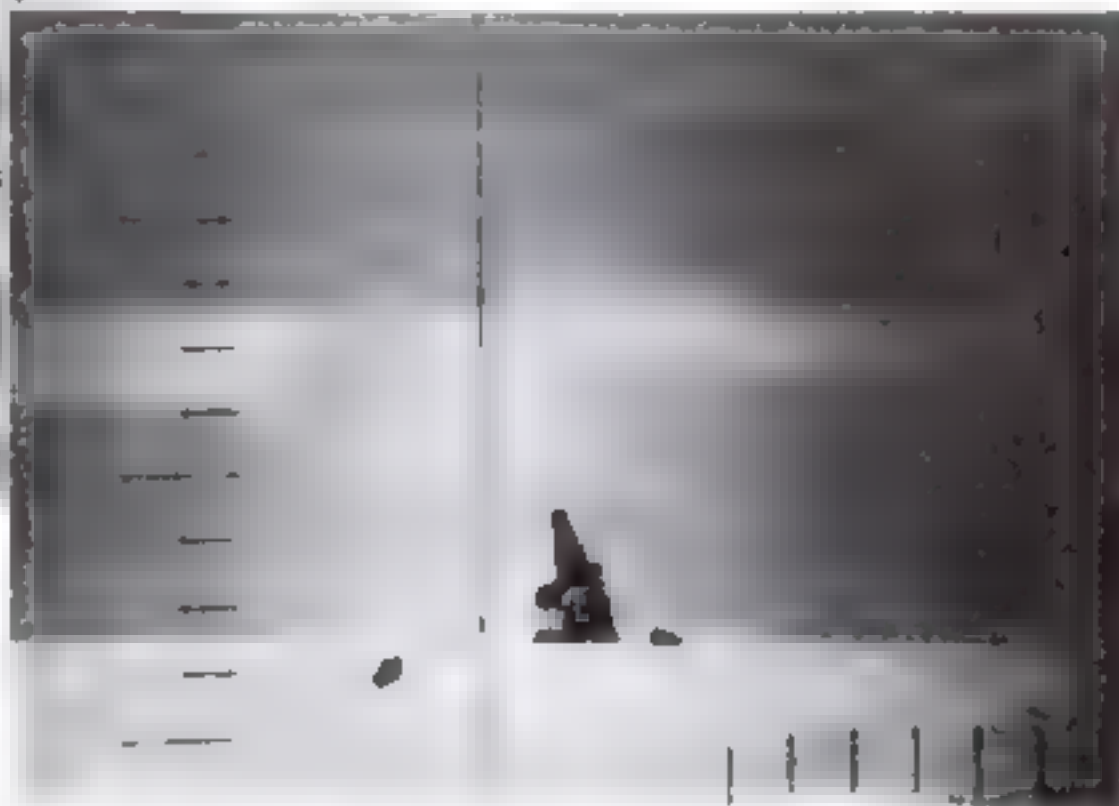
solvent, and polish gently with lens tissue.

Before replacing the lens unit, clean all other lenses of the system and touch up the black coating of inside surfaces, if necessary, with nonreflecting optical lacquer. Do not clamp lens elements too tightly when replacing them.—MORTON WALLING.



Eastman's new periscope camera is received above for use in a submarine. At right, a typical official U. S. Navy photo of a Jap vessel plunging to the bottom.

PHOTOS OF SINKING SHIPS are now being taken through the periscopes of our submarines with a new Eastman camera adapted for holding to a matched mount on the periscope. No focusing or setting of the diaphragm is necessary, light conditions being compensated for by changing shutter speed. Also in use on submarines is a special 16-mm. movie camera designed by Eastman for mounting on a plate that is snapped into place on the periscope. The still camera is used for recording sinkings of enemy vessels, while the movie camera is used for photographing enemy shore lines.



WHEN JACK LONDON covered the Russo-Japanese war 40 years ago, he, too, went equipped with a camera for a picture record as well as a written one. Jack London's old "folding" camera is shown at the right above being examined by a cadet at the Army Air Forces training command school at Yale University. Its modern counterpart is shown at left.

HOW AN ELECTRIC SHAVER clips a beard is studied microscopically in the engineering division of Schick Incorporated, of Stamford, Conn., with the aid of a microstroboscope that can be used either visually, as shown below, or photographically. The regular shaver motor and body are used with the shearing head moved to one side and slotted to provide a sight for viewing. Its speed of 7,200 movements per minute is "stopped" by the stroboscope.





Scantly clad beauties, props, and a technician in the background usually mean that a commercial ad is in the making, but here the technician is a GI and the shot will take its place among his pin-ups.

Below, Mr. Oppenheimer discusses technique with a corporal while a lieutenant takes a light reading.



G. I.'s Photograph Their Own Pin-Ups

SERVICEMEN may go to Carl Oppenheimer's photographic studio in New York any day between five and eight in the afternoon to make their own pin-up pictures. He permits them free use of all his equipment—cameras, films, lights, props, darkrooms, and chemicals—and he stands around ready to assist and advise them at every step, from the lighting to the finished print.

Cooperating with him are models from the Pat Allen agency who make their contribution to the war effort by donating their time to this unique "canteen" for camera fans.

Through the medium of the accompanying photos you may sit in on a typical session at the studio with the GI's, the models, and the benevolent Mr. Oppenheimer.



Here the corporal puts the finishing touches on a model's coiffure while Carl Oppenheimer hands out valuable advice and the natty lieutenant kibitzes.

In the darkroom, two of Uncle Sam's fighters learn the intricacies of operating an overhead enlarger.



How Safe Is Your



When your car is next on a grease rack, inspect the exhaust system carefully—its failure can ruin your engine or even take your life

By **TOM McCAHILL**

PROBABLY no parts of an automobile receive less attention, even from conscientious motorists, than those in the exhaust system. And yet, far from being free from wear because of its lack of moving elements, the exhaust line is subject to deterioration unequalled by that of any other unit.

Faults are not readily discernible, and the average driver is apt to remain falsely assured as long as the exhaust is muffled. This is doubly unfortunate for, aside from the mechanical failures that can be traced directly to faulty exhaust, the carbon monoxide discharged from an automobile motor is a relentless killer. Even small amounts of this odorless, hard-to-detect gas produce drowsiness, and this in turn can lead to serious accident. The danger is lessened in

summer, for carbon monoxide dissipates quickly in fresh air; but in the winter, with windows tightly closed, leaks in the exhaust system can fill a car in a short time.

There are several sources from which carbon monoxide can seep into the body of a car, the most common being from a leaking exhaust manifold. This unit is under the hood directly in front of the dashboard through which the engine fan can force fumes. Holes for wiring are not often sealed, nor are the spaces around a steering post, clutch, brake, and accelerator, and these offer a ready entrance for the deadly gas. Badly fitting floor boards extend the same invitation to gas from leaks in a muffler or in exhaust pipes. These parts are in the open, but forced drafts created by the movement of the vehicle can send much of the exhaust from them into the car.

An easy method of testing for exhaust and muffler leaks is to disconnect the windshield-wiper hose and introduce a small amount of light oil into it while the engine is running. Any light

crankcase oil will serve the purpose, and it is a good idea to speed the engine to about a quarter throttle to avoid stalling. The vacuum in the intake manifold will suck all the oil from the container used, and an extremely heavy exhaust smoke will result. Two or three ounces of oil will produce smoke for several minutes, long enough for a thorough inspection.

Have an assistant partially restrict the exhaust at the tail outlet by holding a board or a wad of rags over the opening. This will cause excess pressure in the exhaust system and force the smoke through any openings or cracks that are present. If you have no helper, the exhaust can be restricted by temporarily jamming a wedge-shaped (not round) piece of wood into the outlet.

Most leaks will be found around the

Car's Exhaust System?

manifold gaskets or at the muffler where it is connected to the pipes. Manifold leaks can frequently be stopped by tightening the bolts that hold the unit to the engine. If this fails, a new set of gaskets is needed. Leaks at the muffler connections are usually the result of pipes working loose because of vibration. Pull the pipes from the muffler, clean the ends with penetrating oil and steel wool, and reinsert them firmly.

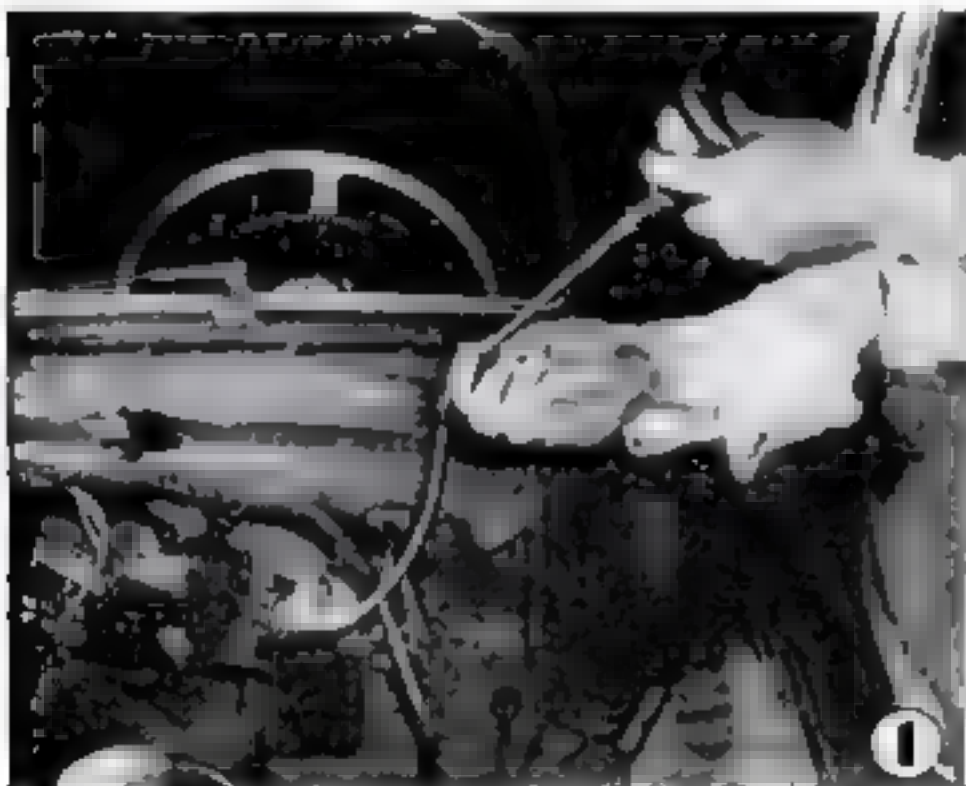
Cracks in the muffler housing and exhaust pipes are a different problem, resulting most often from inside corrosion. Patching is poor practice when this is the case, and a new unit should be installed. In the rare instance, however, where a muffler has been punctured from the outside, stovepipe will make an effective patch. Split the stovepipe lengthwise with a hacksaw, wrap the muffler with two layers of heavy sheet asbestos, put the stovepipe around this, overlapping the ends a few inches, and clamp it tight with strap-iron clamps.

Most mechanical damage caused by a faulty exhaust can be laid to back pressure—an abnormal pressure built up in the ex-

haust circuit by restriction resulting ordinarily from a bent or crushed exhaust pipe. Driving on high-crowned country roads or in heavy snow can damage a pipe or muffler, as can flying stones or a rear-end collision in which the bumper of the other car hits the tail pipe and buckles the line.

Back pressure is also caused internally by corrosion. For every gallon of gasoline burned, a gallon of water is produced by heat and condensation, and this passes into the exhaust circuit, tending to rust the iron and steel walls. Most gasoline also contains sulphur and bromine which combine to form a corrosive exhaust acid. These corrosive elements build up scales that in time fill the pipes and the baffle plates or perforated tubes in the muffler, collecting natural exhaust soot that further adds to the stoppage. Corrosion often is sufficient to dislodge baffle plates or tubes and form greater restrictions.

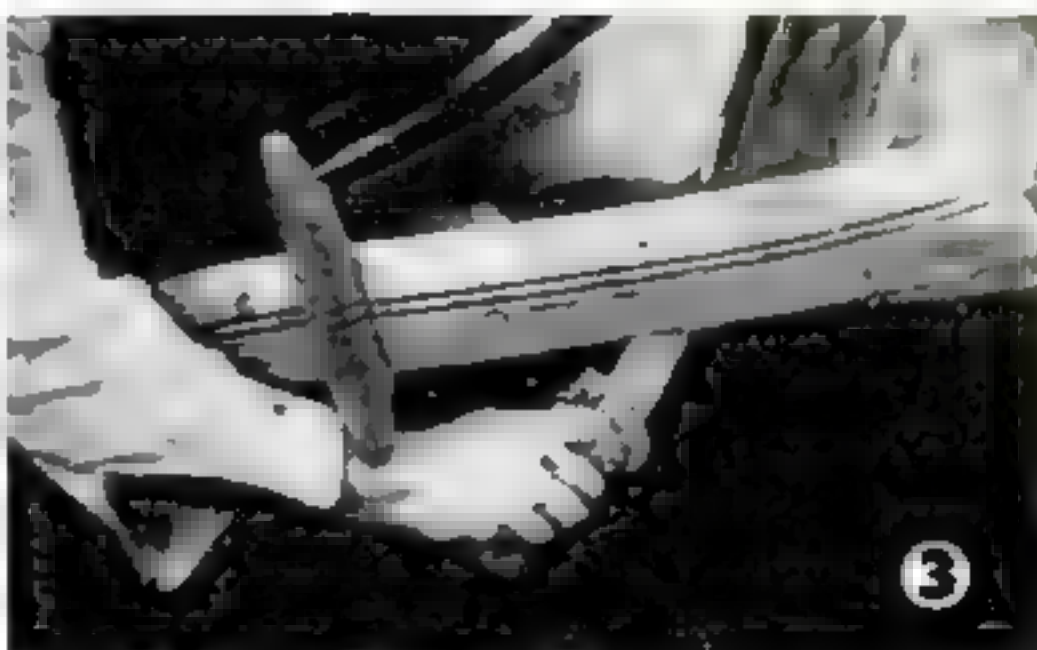
A sure way of retarding corrosion is not to start your motor unless you intend to let it warm up thoroughly. Short runs deteriorate mufflers rapidly, for during them



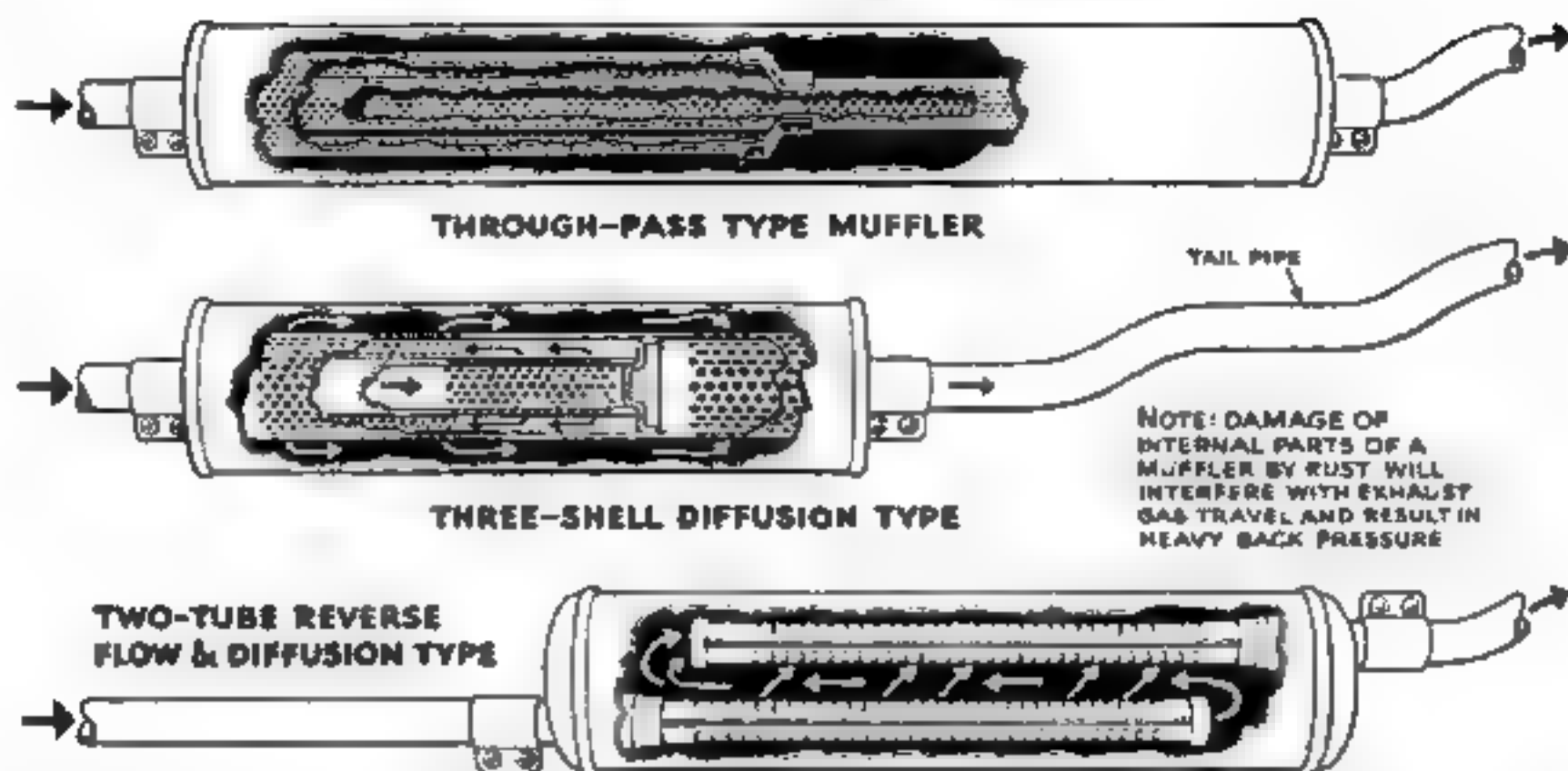
1 Leaks in the muffler or exhaust pipes can be spotted by disconnecting the windshield-wiper hose and allowing it to suck up a little light oil

2 Two or three ounces of oil will produce heavy smoke in the exhaust for several minutes—long enough for you to make a thorough inspection

3 Have a helper partially restrict the exhaust by holding a wad of rags over the outlet as you watch for smoke leaking at cracks and joints



COMMON TYPES OF MUFFLERS



the exhaust system does not have a chance to heat to a point where moisture is vaporized. Some mufflers are plated inside with lead or a tin alloy, and this tends to prolong their life, but heat and acids from a long run at high speed may melt the plating away and expose the bare metal.

Among the most annoying failures traced to back pressure are burned-out exhaust valves. Exhaust temperatures reach extreme heights and, unless this heat is carried away swiftly, the valves may burn out in a matter of a few miles.

Crankcase oil often becomes contaminated by gases that are present in the crankcase in greatly increased volume when back pressure exists, and contaminated oil can ruin bearings and wall surfaces.

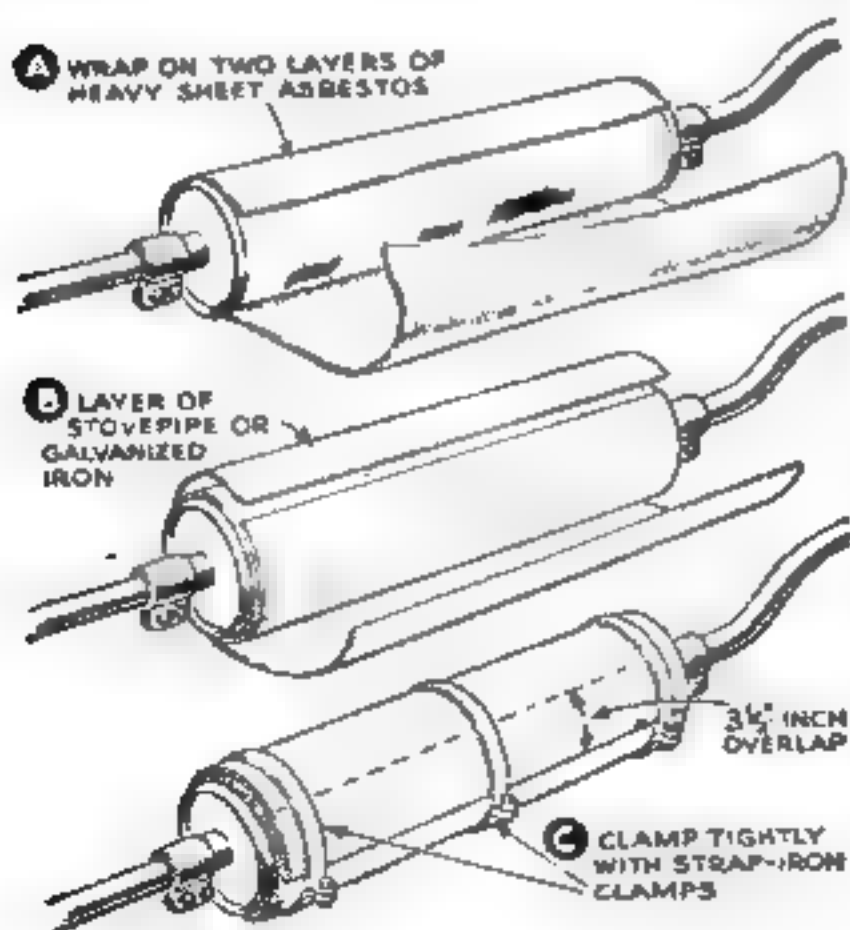
Sometimes one of the most difficult breakdowns to trace is a boiling radiator. Auto-

mobile servicemen have treated a supposedly defective radiator, boiling it out and blasting its cooling walls with steam repeatedly without results, only to learn the cause of the trouble when a break occurred in the exhaust line and released the pressure. Each automobile cooling unit is designed to handle a given heat in a given time, and when back pressure raises the internal heat in the combustion chambers and around the exhaust ports, the cooling system is often unable to take care of the excessive load.

Back pressure greatly decreases gas mileage and kills acceleration by preventing scavenging of the burned gases and thus much reducing the volumetric efficiency of the fresh charges in the cylinders. Spark plugs can be ruined by the heat of back pressure which is sometimes sufficient to crack the porcelain.

Testing for back pressure is difficult, but there are several symptoms that can be easily recognized. The engine runs warmer than usual, acceleration falls off, and the motor is rough at idling speeds. A volumetric-efficiency tester is used at the factory to determine back pressure, but service stations and garages rely chiefly on experience and judgment.

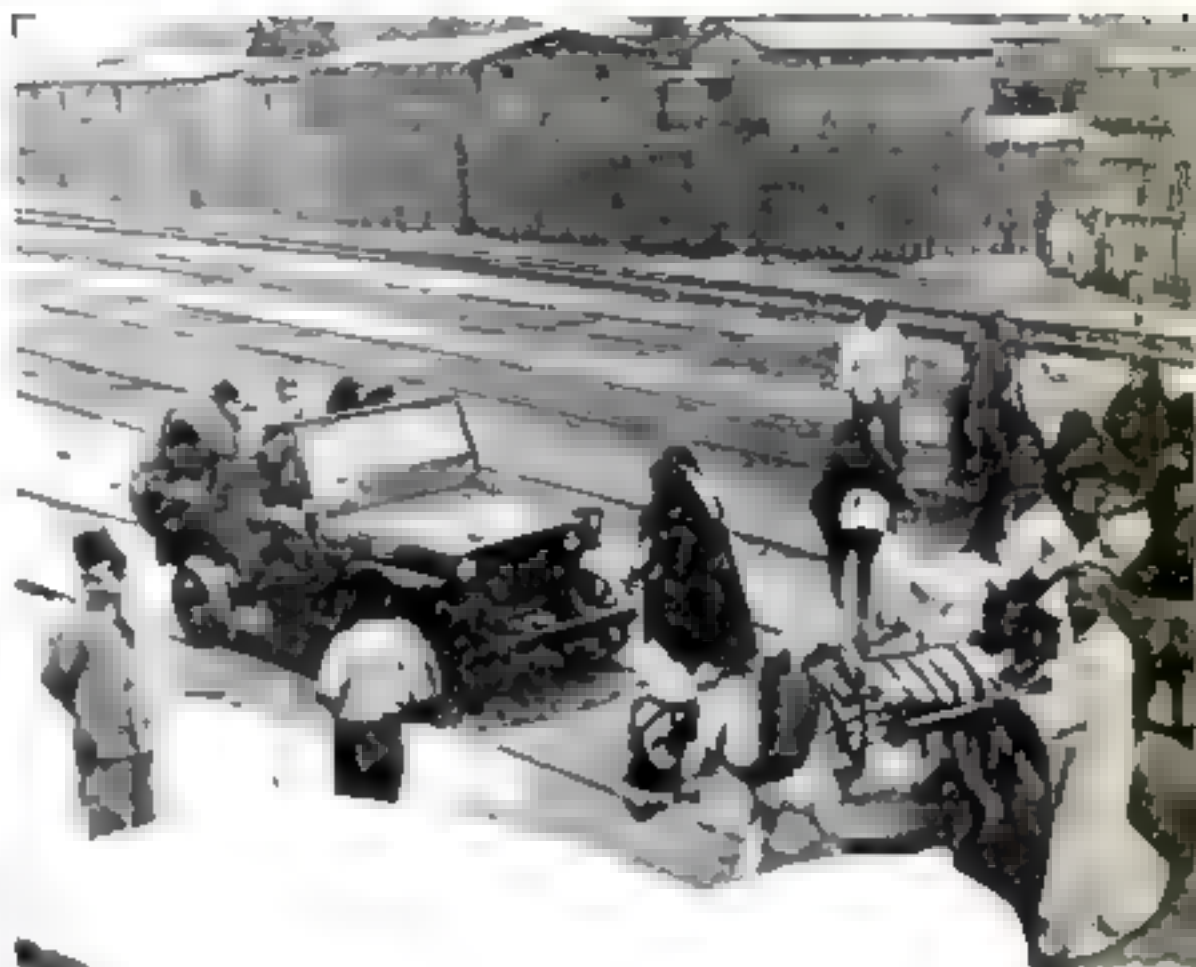
Where back pressure is suspected, it is a good idea to attach a vacuum gauge (see P.S.M., Sept. 1944, p. 142) to the intake manifold and note the reading at idling speed. Then disconnect the muffler from the pipe leading from the exhaust manifold. If there is an immediate rise in vacuum, you can be sure that back pressure existed in one of the disconnected parts, for the efficiency of an engine can be measured by the vacuum on a set throttle. In cases where back pressure is severe, the improvement on disconnecting the muffler should be noticeable even without a gauge.



WEAR ON TIRE TREADS has been measured by the National Bureau of Standards by the simple process of weighing tires at intervals during driving tests and checking on the loss of weight. An ordinary but exceedingly accurate 4' balance beam was used with a pointer and graduated scale, as shown below. The method required a minimum of work and relatively few miles of driving to indicate reasonably reliable rates of wear with which to predict the life of a given tread. Synthetic rubber of the type being fabricated now was found almost as good as natural rubber in wearing qualities.

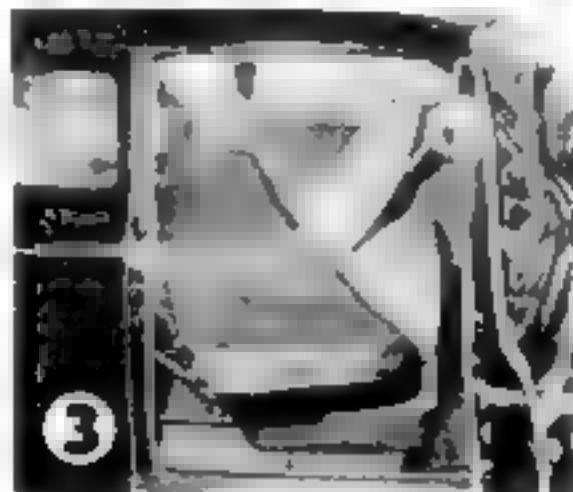
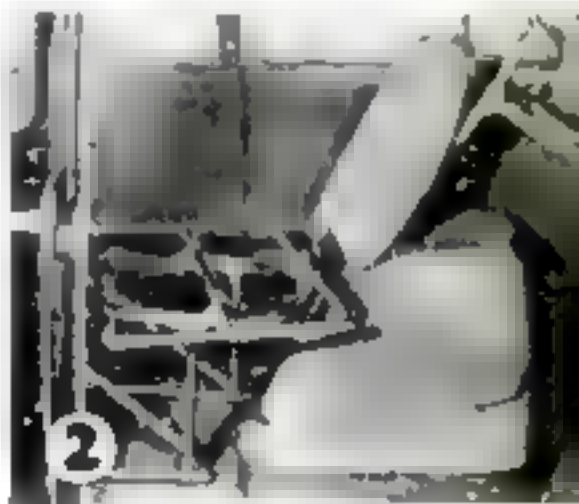
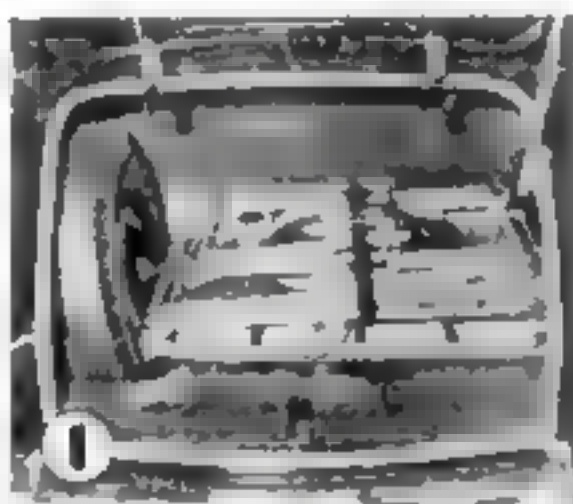


VALVE GUIDES are conditioned efficiently by using an adjustable stem-guide cleaner designed especially for removal of tenacious, varnish-like deposits in the guide holes. The tool, manufactured by New Britain, comes in several sizes, all equipped with hardened spring-steel blades that may be reversed or replaced when necessary. It can be driven in the chuck of an electric drill plugged in at any convenient outlet.



IRON WHEELS ON A JEEP adapt it quickly for railroad work, still another use found by the Allies for this versatile military car. Flanged wheels are carried in brackets—where the regular wheels are shown in the photo above—without encroaching on passenger room when the jeep isn't riding the rails in locomotive fashion.

AN EMERGENCY STRETCHER that folds for storage in a car trunk (Fig. 1) will convert a two-door sedan into an ambulance. It consists of a frame on a turntable (Fig. 2) and a pad (Fig. 3), which are shown swung out to receive a patient. After the patient is taken aboard, the stretcher is rotated as in Fig. 4 so the door may be closed.



Gus and the Car



"Hey, Gus!" a rasping voice demanded.
"Wake up and gimme a half dozen fuses."

JOE CLARK had gone down to the bank that morning, and Gus Wilson was pinch-hitting for him in the office. Gus is as industrious a man as we have in our town—when he is in his shop. But because he hates offices and office work, he's always been more than satisfied to leave the business and bookkeeping end of the Model Garage to his ambitious and energetic partner, and on the rare occasions when he has to take Joe's place "out front" for a few hours, he always grouses first and then indulges himself in a spell of good old-fashioned loafing.

That's what he was doing now—loafing. His pipe in his mouth, his chair tilted back at a precarious and comfortable angle, and his feet on Joe's orderly desk, he was reading the paper with a thoroughness that ordinarily he is able to indulge in only on Sundays.

A rasping voice brought him back from the war. "Hey, Gus!" it demanded. "Wake up and gimme a half dozen fuses."

Gus looked over the top of his paper and saw Vern Hopkins' long, lean, and grouchy face.

"Hello, there, Vern," he said cheerfully. "What the heck do you want a half dozen fuses for? Never thought you'd turn out to be a hoarder!"

"I'm not a hoarder, and you know it," Vern growled. "I need a lot of fuses because fuses keep blowing on me."

Gus dropped his feet from Joe's desk and employed them in taking his 190 pounds into the stockroom and back.

"Here are your fuses." He handed them over. "And here's a thought that maybe you'll find worth while to allow to percolate slowly through your mind: When a car blows a lot of

By **MARTIN BUNN**

That Hated Red Lights

fuses, there are just two things that you can do about it—you can find the cause and fix it, or you can go on buying fuses and cussing. The first way is cheaper and a lot less trouble."

Vern grunted disdainfully. "I suppose you think I never thought of that," he said. "Well, I did—I took your advice before you gave it. For the last week I've been spending half my time trying to find out what the heck's the matter with this darned car. Nothing's the matter with it, so far as I can see—and still it blows fuses."

Vern paused a moment to let this sink in, and then, with a sneering tone in his rasping voice, he added slowly and meaningfully: "But you're the automotive whiz of this burg. Suppose you try now, and see what you can make of it."

Gus sat down, hoisted his feet back on Joe's desk, and reached for his paper. "Can't you see I'm busy?" he said. "I'm holding the fort while Joe's downtown—I promised him I wouldn't stir out of the office until he got back. I haven't got time to bother with details—I'm *managing* this concern! Stan's in the shop—ask him to take a look at your bus."

"Stan!" Vern said contemptuously. "That grease monkey! This isn't some simple little thing that Stan can find. It's a real brain twister!"

"What do you mean—a brain twister?" Gus scoffed. "You don't think you're the first driver who's had a fuse blow, do you?"

"No," Vern retorted, "I don't. But I'll bet anything you like that I'm the first driver who's had his car blow a fuse every single time it's stopped by a red light!"

This was right down Gus's alley. He tried to look disinterested, but he couldn't help dropping his feet gently to the floor. He knew Vern wasn't kidding him—Vern is an impatient, hot-tempered fellow who is too much of a chronic grouch to be a kidder. This was going to be a trouble-shooting job that would be really worth while!

"Do you mean to tell me," he asked, "that you blow a fuse every time you stop for a red light, and that you never blow one any other time? That sounds 100-percent screwy."

"Well, it's not just like that," Vern admitted. "But I've had maybe half a dozen fuses blow out in the last week, and four times it's happened

when I've been stopped by a traffic light. I'm on the night shift now, and what makes me mad is that it always happens when I'm hurrying to get to the plant."

"You've got your car outside, haven't you?" Gus said. "O.K.—drive it into the shop. I'll take a look at it—just to prove you're nuts!"

Leaving the office to look after itself, Gus went into the shop, and Vern followed shortly, driving his sedan.

"Going to wait?" Gus asked him. "Chances are you've got a short somewhere in your lighting circuit. I might find it right away, and then again I might have to hunt for it for quite a while."

Vern grinned sourly. "Take it from me," he said, "you'll have to hunt. I did! But I'll wait. I want to use the car—and besides, I want to see you sweat!"

"O.K.," Gus said. "Enjoy yourself. Just keep out of my way."

Switching on the lights, he checked over the parts most likely to cause the trouble. The headlights burned satisfactorily, both on the high beam and dimmed. There were no loose or dirty connections at the ammeter or between the generator, the ammeter, and the battery to cause generator voltage to be built up. Both the headlight switch and the dimming switch were in perfect condition. So were the lamp bases. The leads were of adequate size, and Vern grunted a gruff "No" when Gus asked if any of them had been replaced recently. He took the fuse out of its clips on the inside of the

It blew a fuse every time it was stopped by a red light



dash and examined it. Its capacity was large enough to carry the circuit's normal current. The fuse clips were clean, and the ends of the fuse made good contact with them.

Gus paused to scratch his ear reflectively.

"Up a tree, aren't you, Hawkshaw?" Vern sneered.

"Looks like it," Gus admitted good-humoredly. "So far as I can see, your lighting circuit's in perfect condition. But let's see what happens with the engine running."

He started the engine, allowed it to idle, and checked the generator voltage. It was normal. He speeded up the engine, and checked the voltage again. It still was normal.

"Well, I hope you're satisfied," Vern snarled when Gus got out of the car. "You haven't done anything that I haven't done a dozen times. I told you that everything was O.K.—except when I have to stop for a red light. I'm not going to waste any more time hanging around here—I've got some errands to do for my wife, and then I've got to get some sleep. What do I owe you?"

"You don't owe me anything—except for the fuses," Gus told him. "But you'd do a lot better to leave your car here. Fuses don't blow without a reason, and putting in a new one without finding out what made the old one blow isn't curing anything—it's just being dumb. You'd better —"

"I'm going!" Vern snapped. He paid for the fuses, jumped into his car, and started backing off fast toward the shop door. Gus noticed the lights hadn't been switched off and called to him, but he wouldn't pay any attention. As he neared the door he had to jam his brakes on to avoid another car that was being driven in. Vern honked his horn three or four times and raced his engine impatiently—and Gus saw the headlights go out. He shouted again, but Vern backed out, turned quickly, and drove off.

"By George, he's blown another fuse!" Gus muttered. "I wonder what the dickens . . . Well, I'm glad I haven't got that guy's temper. Fuse . . . temper . . . red light. By gum, that might be the answer!"

THE next morning Gus phoned Vern. "Have any fuse trouble last night?" he inquired innocently.

"Nothing but trouble!" Vern growled. "The fuse was blown when I started for the plant. I put in a new one, and that blew too."

"Where?" Gus asked.

"Where do you think?" Vern yelled. "At a red light, of course!"

Gus laughed. "What time are you leaving for the plant tonight?"

"Half past eleven," Vern told him. "What's it to you?"

"Make it an hour earlier," Gus said, "and let me ride with you. I think I've got your fuse trouble licked. O.K.?"

"Oh, all right," Vern agreed ungraciously.

WHEN Vern came out of his house to start for work that night, Gus was waiting on the sidewalk.

"What's the big idea of making me get up an hour early?" Vern grouched.

"You'll see," Gus said. "Let's get going."

Vern drove out of the garage, and Gus got into the car. "Fuse all right?" he asked. Vern grunted assent.

They drove out of the side street and headed down the busy highway. Several blocks ahead of them a traffic light showed green. Vern increased the car's speed, and Gus knew that he was trying to beat the change of the light. But the traffic was sticky, and before they got to the intersection the light showed yellow and then red.

Vern kicked on his brakes and swore; then he began to race his engine impatiently. Suddenly the headlights went out.

"What did I tell you?" Vern yelled. "Another fuse blown! It's that red light that does it!"

"Keep your shirt on," Gus told him. "It's not red lights that make you blow your fuses—it's a combination of something mechanically wrong with your car and your hot temper. Pull over to the curb while we put in a new fuse. Then take it easy until we get down to the shop, and I'll soon find out what's wrong."

When they got to the Model Garage, Gus switched on the shop lights and went to work. Convinced now that the blowing of the fuses had been in some way caused by the racing of the engine, he raised the hood, told Vern to gun the engine, and watched closely to see what happened.

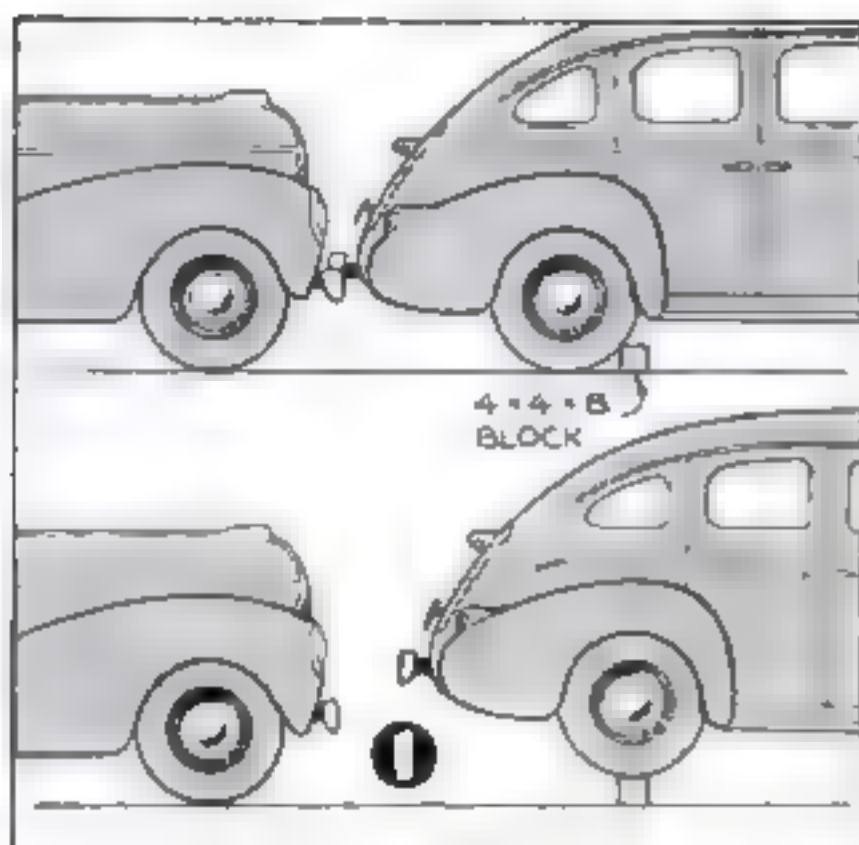
The headlights went out almost immediately.

"There goes another fuse," he told Vern. "All right—keep her turning over." He watched for half a minute. "Switch her off," he said then. "I think I've got it."

Vern got out of the car. "Your fan moves back and forward when you gun the engine," Gus told him, "and when it gets to its extreme forward position the tip of the fan blade hits the headlight cable. That causes a short, and the fuse blows. Here's the cause of the grief. Your water pump is so shot there is excessive end play in the shaft, and that lets the fan move forward."

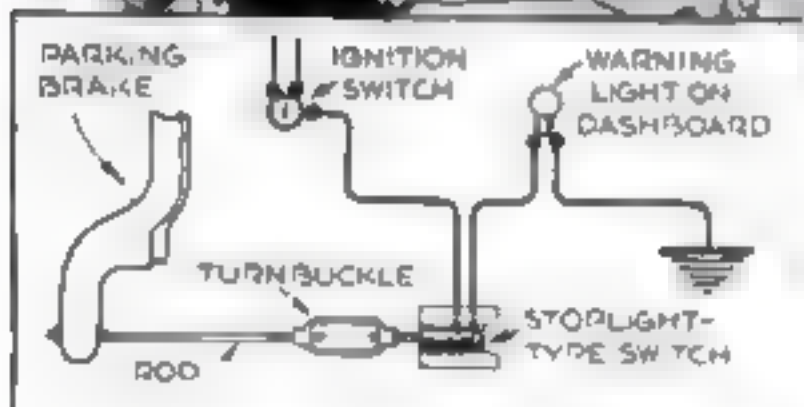
"I'll shift the headlight cable now so the fan blade can't touch it. That'll do for tonight, but tomorrow you'd better bring the car in and let me repair that pump before it begins leaking so bad your engine runs as hot as your temper."

USEFUL AUTO HINTS



1 LOCKED BUMPERS can be released with a minimum of effort if you carry in your tool compartment a pair of 4" by 4" blocks that can be placed against the wheels of the car having the uppermost bumper. Start this car slowly, and be ready to stop the other car as soon as the wheels of the first mount the blocks and the bumper clears—this keeps the following car from crashing into the raised bumper.—H. L. K.

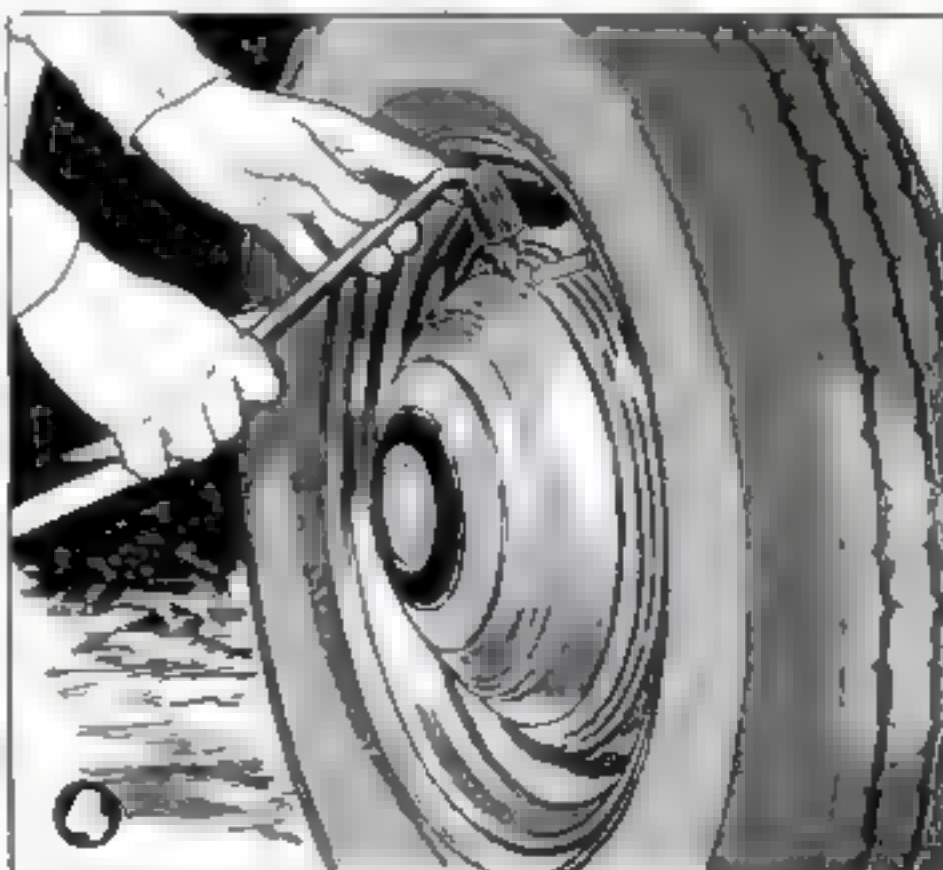
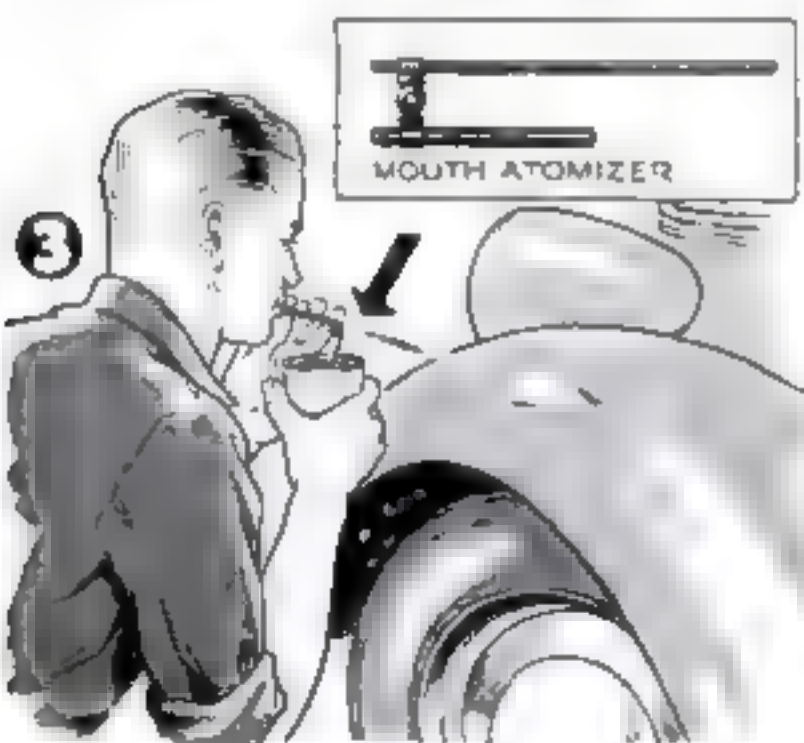
2 FORGETTING TO RELEASE A HAND BRAKE is guarded against by rigging up a warning light on the dashboard. Drill the brake lever to take a rod attached through a turnbuckle to a switch of the kind used for stop lights. Connect the wire at the ignition-switch coil terminal, so that the signal is given only when the ignition is on.—A. M.



3 TOUCHING-UP JOBS where paint has been knocked off your car may be done without fear of brush marks or laps if you use a mouth atomizer of the type sold by art-supply stores. Sand off loose paint and rust before applying the new enamel, and practice with the atomizer and enamel against a sheet of metal to get blowing force and distance right.—E. S. M.

4 REMOVAL OF A HUB CAP is accomplished without marring the finish on the wheel if a small ripping bar of the type shown is fitted with a short length cut from ordinary garden hose. A notch may be needed in one end of the hose so it will go up over the gooseneck.—W. E. B.

Drawings by William Patrick





ANTIMILDEW SPRAY applied to leather, canvas, and woolen articles that have first been wiped dry will be found a good preservative. Such a fungicide for home use is now being manufactured by the Interchemical Corporation, of Fair Lawn, N. J. It may be used on walls, floors, and furniture as well as on stored goods.



MANICURING YOUR NAILS can be an easy chore with a new combination file, nail cleaner, and brush now available. The brush is used dry to finish cleaning the nails after washing and drying the hands. W. E. Shore, of Staten Island, N. Y., is the maker.

CAN OPENERS of the wall bracket type are again available though only two models from a large line will be made for the duration. Simply turning a crank will take off the tops of round or square cans, and bottoms are as easily removed from cans for salvage. The opener manufactured by the Dasey Corporation, of St. Louis, Mo., is available in a light or heavy-duty model.



YOUR POSTWAR WASHING MACHINE may launder much more efficiently as the result of new laboratory methods devised by Westinghouse for determining the amount of residue left in fabrics after rinsing. Instead of testing the used rinse water, Westinghouse cuts a sample from the fabric itself after each successive washing and burns it. The ash produced, which is indicative of unrinsed solids, is found to be larger after each washing by normal methods. At left below is the ash from a sample washed once, at the right the ash after 100 washings. Better rinsing methods are being studied.

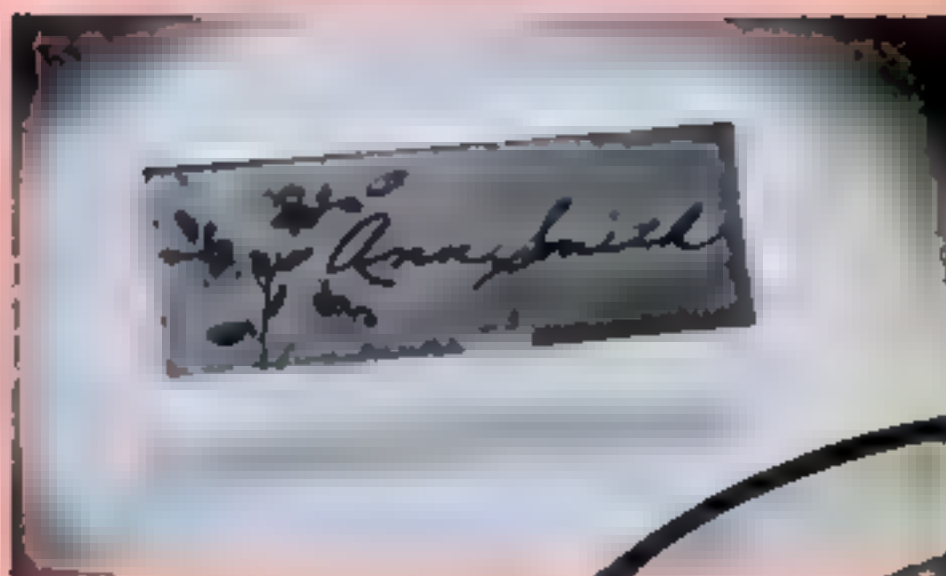


What's New in Modern Living

NEW ALUMINUM FINISHES and new alloys and processes developed for war use are sure to add something new to the postwar home. Examples of the possibilities are wall panels, decorative trim, and mesh draperies, and enameled and polished aluminum dresser sets. Those shown are from Aluminum News-Letter, of the Aluminum Company of America



AIR IS FRESHENED QUICKLY and smoke and cooking odors are removed by an ozone generator resembling a midget radio and started simply by the pressing of a switch. The little machine, housed in a 4 1/2" by 5 1/4" by 6 1/4" plastic case, is available at Lewis & Canger of New York. It can be attached to any household A.C. outlet. Operation is economical



NEAT GLASS PLACE CARDS are now available with silvered backs and fronts bearing a design and a frosted strip on which a guest's name may be written. They are made by the Glass Craftsmen, of Los Angeles, Calif.

THIS PLASTIC FLASHLIGHT with a right-angle beam is waterproof, is equipped with permanent and signal switches, and has a clip to hold it to the belt. The manufacturer is the Allbright Electric Corp., of New York





Delicate lockets like these are shaped from easily mixed resins in homemade molds, that at the lower center in two spoons. The emblems and paintings are embedded in them

Molding Jewelry Plastic at Home

**BEAUTIFUL PIECES ARE EASY
TO MAKE WITH SIMPLE TOOLS**

By Evelyn Hayden Humphrey

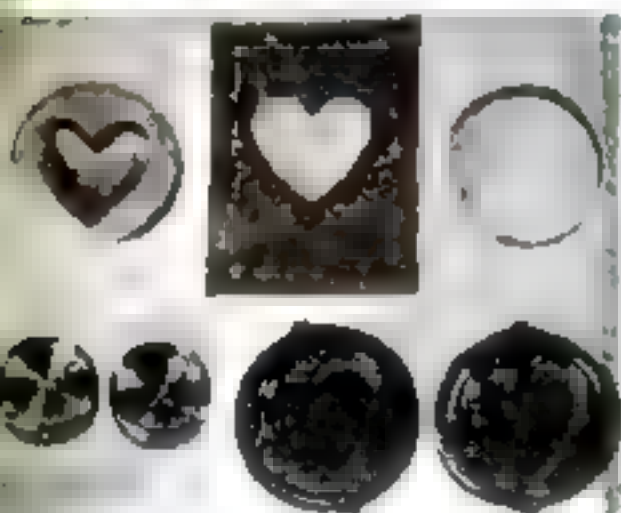
COSTUME jewelry, beautiful clear and tinted lockets, and specially designed dress buttons can be molded right in your kitchen or basement workshop with no experience and with commonplace tools. After a little practice, you will be able to contrive exquisite pieces, imprisoning delicate oil paintings, crests, military emblems, religious medals, and photographs in lustrous plastic. When your personal collection is complete, you can derive pleasure from making dainty gifts for your friends, or you may even turn your new craft into a paying commercial project.

The materials you will need for this interesting work are acrylic resins. Lucite, Plexiglass, and Crystalite, which have become familiar in many forms, are all acrylic resins, and dentists also use the resins for making dental plates. Acrylic resins are water clear, but they may be colored with dyes and pigments. They are thermoplastic—they soften when heated and harden when cooled.

You may obtain a ½-lb. package for a few dollars at a dental-supply house—enough to make a large number of small articles. Be sure you specify *clear* acrylic resin. The package will contain a bottle of liquid monomer and another of finely powdered polymer. Monomer is the resin in its thin, clear liquid form and has a pungent odor; polymer is the same resin, but of a different molecular structure, and is a clear solid. When heated, the monomer shrinks and solidifies to form the polymer. The powdered polymer moistened with a little of the monomer makes a soft, snow-like mass which, when squeezed in a mold, boiled in water, and then cooled, comes out as a clear, hardened plastic. This is the method used by dentists.

If you have a lathe, the simplest

Here are a brass mold ready for its ring, a pattern, the ring, button molds, molds in pipe caps



Brass shim stock is burnished in the pattern and then soldered on pipe caps or rings cut from pipe



Freshly mixed plastic packed in both halves of the mold should be more than enough to fill them



molds will be those for buttons, made as shown in the drawing. The flange illustrated serves to align the halves of the mold and helps in compressing the plastic.

For a hand-shaped design, fret-saw the outline in hard pressed composition board or in hardwood. Anneal a piece of thin brass—.010" shim stock is ideal—and clamp it to the pattern. Burnish the brass into the hole to a uniform depth of $\frac{1}{8}$ " with a rounded-end hardwood stick, soaping the metal for lubrication. Form two such molds.

Next, cut the threaded section off two $1\frac{1}{2}$ " or 2" pipe caps, drill a $\frac{1}{8}$ " hole in the center and two $\frac{1}{8}$ " holes carefully laid out for alignment pins, and solder two pins in the alignment holes in one cap. Lay out and carefully drill alignment holes in the brass pieces, and solder one of these pieces to the open end of each cap so the two will match to form the complete mold. Fill through the back with lead or plaster of Paris. Rings sawed from pipe or tubing can be used instead of pipe caps.

Make your molds with plenty of flat or flash area to aid in compressing the plastic and, at least in the beginning, have them no thicker than $\frac{1}{4}$ " nor larger than $1\frac{1}{4}$ " in diameter for ease in loading with resin. Polish the cavity by buffing or rubbing with grinding compound. Next wipe the mold, a tumbler, and a knife or spatula clean, for dust will show in the clear plastic.

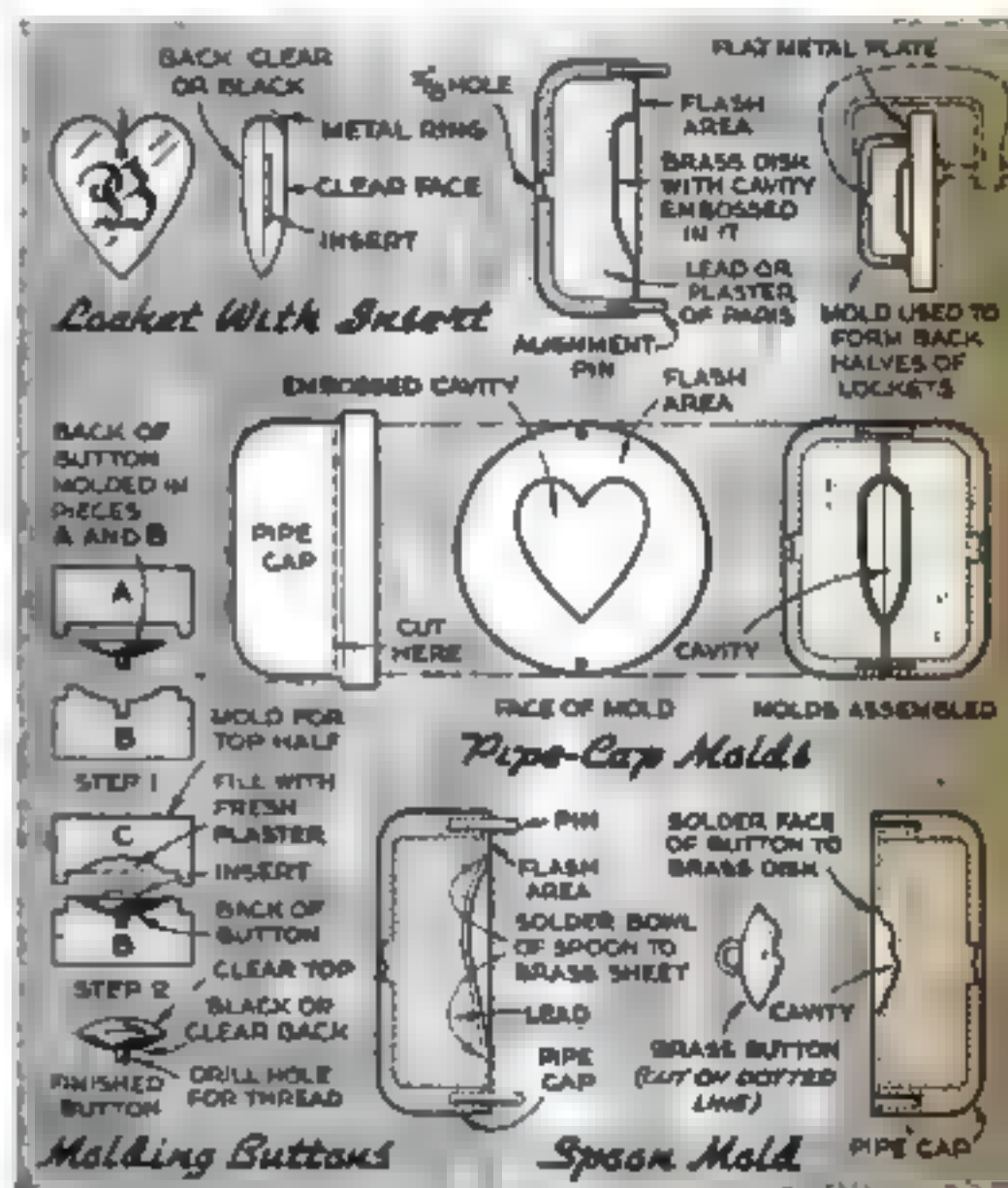
Put in the tumbler a little more than enough powdered polymer to fill both halves of the mold and add the monomer slowly with a clean medicine dropper, mixing until the product has the consistency of moist snow. It should crunch when pressed or, pulled between your thumb and finger, show fine strands. The monomer evaporates, so fill and clamp the mold quickly.

Place the clamped mold in a pan of cold water and heat slowly until the water boils. Allow it to boil for 30 minutes; then plunge the clamped mold into cold water, open it when it is cold, and remove the hardened

plastic. File or grind off the flash, drill for mounting or for hanging on a chain, smooth with fine sandpaper, and polish by buffing or with a soft cloth and jewelers' rouge.

To paint inside a locket, clamp half a mold to a flat surface and form half the piece. This back section may be made clear or colored by adding pigment, dye, or lamp-black to the plastic mix. Paint the flat side of this piece with oil colors, as shown in the photo below, and let dry at least a week. Then replace it in the mold, clamp on the other half mold filled with fresh resin, and heat to complete the job.

Emblems are embedded by first making half a locket as above, leaving it in its mold, placing the emblem on it, clamping on the filled second half of the mold, and reheating.



Molds are clamped together, put in cold water, brought to a boil, and boiled slowly for 30 minutes

Cooled again in cold water, they are opened, and the molded piece in each is removed with a knife

To paint within a locket, mold half the piece first, decorate, and remold with the second half



Keeping Your



Though possibly not as impressive as audible riffling, the old-fashioned overhand shuffle mixes cards just as efficiently and doesn't damage them. In dealing, hold the deck loosely and keep the left thumb busy pushing top cards forward for easier grasping. This will lessen friction and promote longer life

BEFORE war shortages, Blackstone, the great magician, used a new deck of playing cards each time he appeared before an audience. Fancy "exhibition shuffles" and "palming" at home as well as on the stage do something to cards. Regardless of the impressive effect, riffling audibly and forcibly nicks the edges, and in time the nicks become tears. "Springing" cracks and dog-ears a deck, after which it is ready for wastepaper salvage.

If you do not like the old-fashioned overhand shuffle, grasp the sides of each half deck between the thumb and fingers at a 45-deg. angle from the table without curving and release the side pressure gradually. The cards fall quietly and are well shuffled. To deal, hold the deck loosely to avoid friction and keep the left thumb pushing a top card forward so it can be grasped easily.

The high-finish thin stock on the faces and backs of cards protects the resilient board sandwiched between, but moisture works in at the edges, loosening the adhesive and fraying and thickening the edges. A dash of talcum powder on the hands, especially in warm weather, helps prevent this.

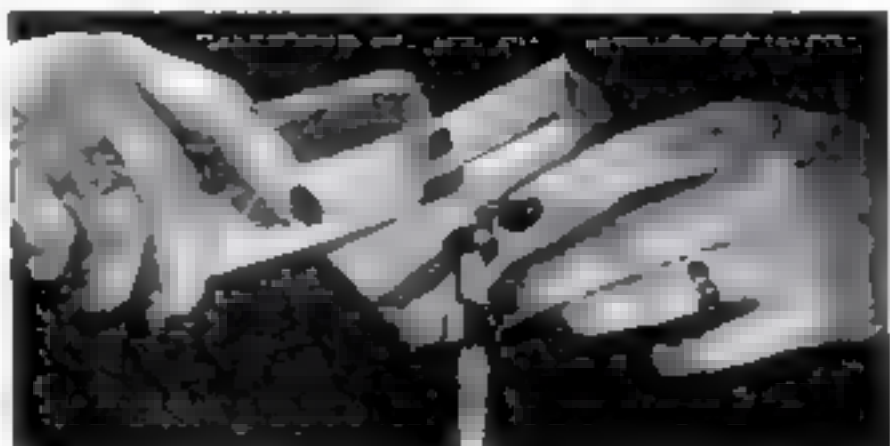
Greasy food and cold drinks are equally as destructive, but a deck can sometimes be restored by dusting each card with talc or cornstarch and wiping off the powder and the grease or moisture it has absorbed. Spots can also be removed with a few drops of cleaning fluid applied

with a clean cloth. Limp cards may be stiffened by placing them individually between sheets of white paper on a smooth, hard surface and pressing with a hot iron. Be careful of scorching.

To trim frayed edges, get them as even as possible and clamp the deck tightly between wood blocks. Wrap fine-grit sandpaper on another block and carefully sand the edges lengthwise until about 1/64" has



DO'S Greasy, dirty cards can be restored by rubbing the spots gently with a little cleaning fluid. Frayed edges are trimmed smooth with sandpaper. Get the edges even, clamp the deck tightly, and sand lengthwise along the sides



Playing Cards on Deck

DON'TS Even if you can't make up your mind which card to play, avoid chewing the corners. It won't help your game and it will speed the deck toward the wastepaper scrap heap. You may get a kick out of showing your prowess at housebuilding, but it's a sure way to ruin cards



been removed. Finish by rounding the corners slightly. For gilt edges, apply merely a touch of gold bronze with a cloth while the deck is still in the clamp. Rub the bronzing liquid over the edges and allow it to dry overnight before removing the clamp.

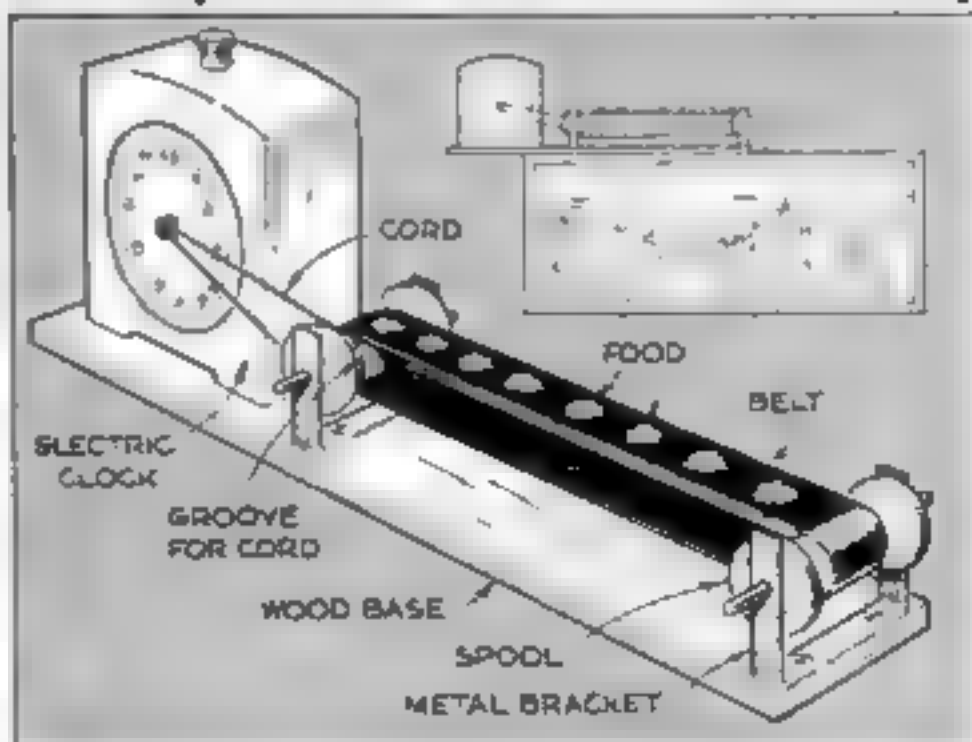
Thin varnish applied by brush, spray, or dipping protects a restored deck. For a

standard formula dissolve $\frac{1}{2}$ oz. gum elemi in 1 oz. denatured alcohol. Or a cellulose lacquer is made with 1 part clear fingernail polish and 1 to 2 parts uncolored polish remover. Both should be of the best grade. Test the lacquer on the joker to be sure the solvent doesn't cause the color printing to "bleed."—KENNETH MURRAY.

Belt Operated by Clock Feeds Aquarium Fish Automatically

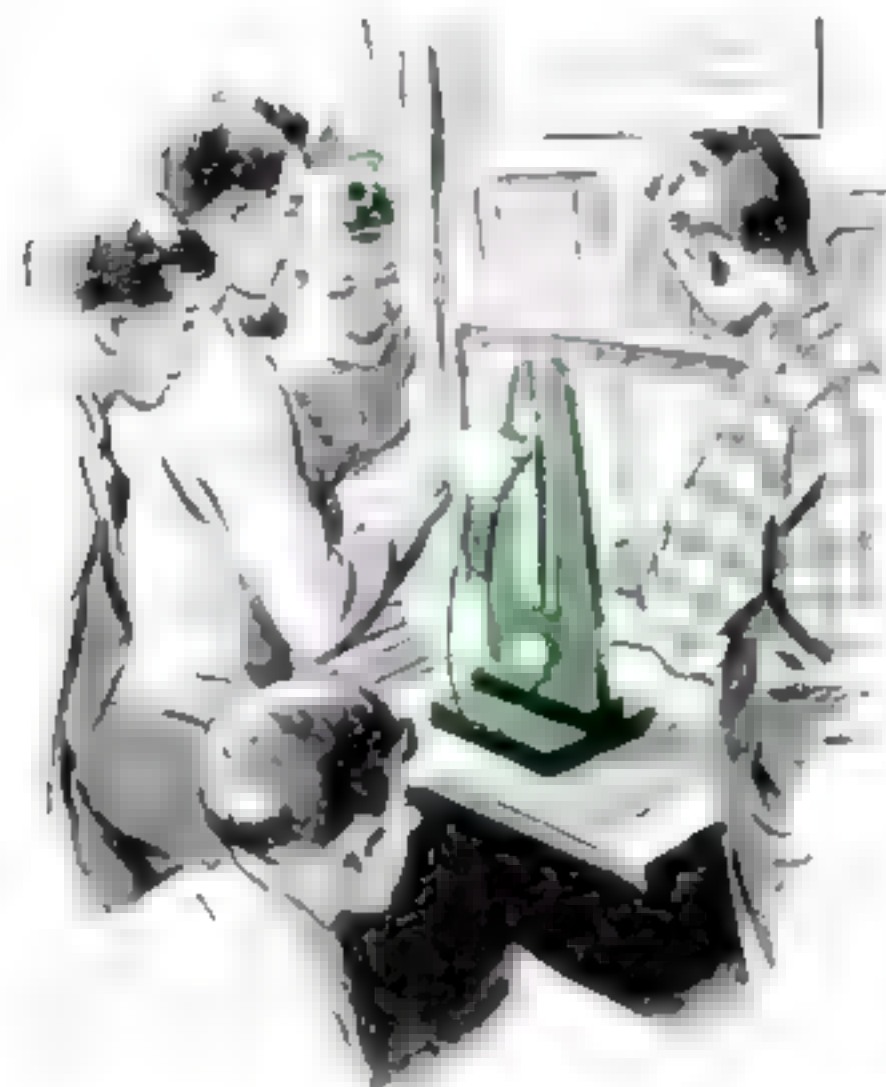
FOOD for a week or longer can be fed to fish in your aquarium while you are away on vacation if you lay it out on a belt turning on spools that get power from an electric clock as shown at right. Use a self-starting clock, attach it to a wood base, and connect it to one of the spools with a strong pulley cord. Press a grooved turning on the hour-hand shaft for one of the pulleys and groove one spool to make the other.

Be sure the spools turn as freely as possible. Light drill rod or big knitting needles cemented into the spool holes will serve as axles. Make the belt of light cloth, preferably with a rough inside surface.—CHARLES T. PEARSON



Vision and Steadiness Tested

SIMPLE BUT SCIENTIFIC DEVICES WILL AMUSE YOU AND YOUR

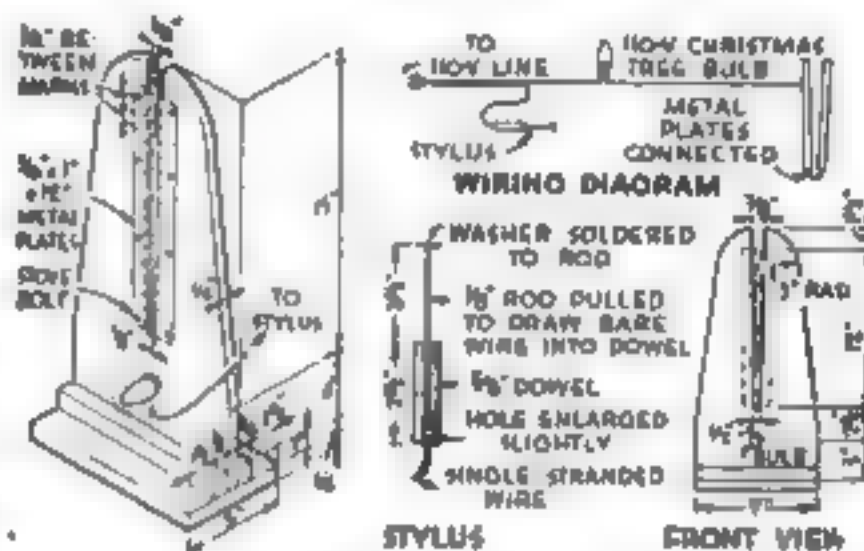


TWO driver tests that are entertaining to try at home with your friends and that also have practical value are those in use for ascertaining steadiness of hand and side sight or field of vision. Simple equipment

designed by the American Automobile Association for such tests is shown in the drawings.

For the steadiness test, cut out a piece of plywood, as indicated in the drawing below, and saw out a slot about 14" long tapering from a width of $\frac{3}{8}$ " at the top to $\frac{1}{2}$ " at the lower end. On each side attach a strip of doubled tin-can stock or other metal so that the inside edges will be $\frac{1}{8}$ " apart at the top and $\frac{1}{2}$ " apart at the bottom. Divide the strips into 16 spaces $\frac{1}{2}$ " apart and number them from 1 to 16 beginning at the top. Wire the scales and stylus as shown.

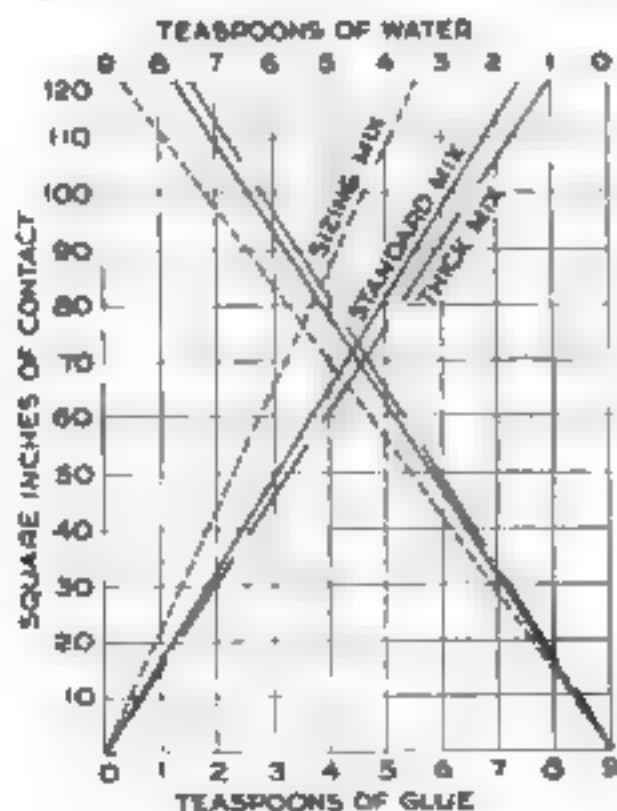
Set the equipment up on a table and plug it into an electric outlet. The stylus must then be worked down from the top as far



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CASEIN-GLUE CHART

[WOODWORKING]



Reference to the guide at left will permit mixing the right amount of glue for a job without waste and, more important, without fear of running short during an assembly. The chart is based on 1.85 oz. mixed glue per square foot of contact, with both surfaces coated. Sizing mix is 1 part glue to 3 parts water by weight; standard mix, 1 to 2; thick mix, 1 to 1.8. For areas larger than those shown on the vertical scale, multiply the readings proportionately.

To use the chart, find the contact area on the vertical scale, say 50 sq. in., which is about the area of 5' of dressed 1" stock. Follow the horizontal line to where it intersects the dry glue line, three teaspoonfuls for standard mix, and the water line, 3 $\frac{1}{4}$ teaspoonfuls for the same mix.

Use standard kitchen measuring spoons or cups. Dip loose glue and scrape it off level, and also dip water.

14 $\frac{1}{2}$	teaspoonfuls dry glue equals	1 oz.
13 $\frac{1}{2}$	"	$\frac{1}{2}$ cup.
7 $\frac{1}{2}$	"	1 oz.
13	"	$\frac{1}{4}$ cup.

POPULAR SCIENCE MONTHLY SHOP DATA

by Homemade Equipment

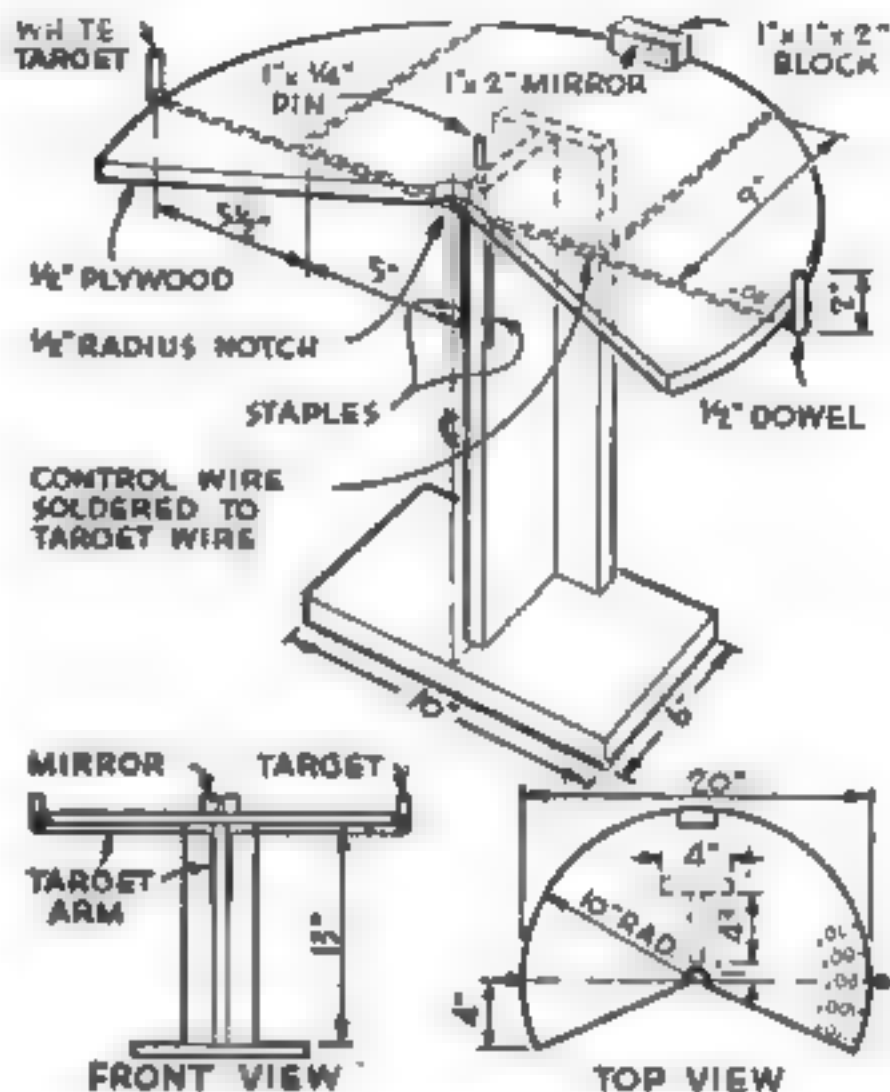
FRIENDS AND ALSO PROVIDE INFORMATION OF PRACTICAL VALUE

as possible without touching either metal plate. A score is recorded when it touches and completes the electric circuit, thus lighting the bulb. The contestant should stand squarely in front of the test board without bracing himself. The stylus may be in either hand.

Two practice trials may be allowed, and then the score should be added for five trials. From 60 to 80 is excellent, 50 to 59 good, 40 to 49 average, 30 to 39 fair, and 0 to 29 poor.

Construct the field-of-vision test device as shown at the right, arranging the movable white targets on either side so that they can be swung independently of each other by means of the control wires. Both halves of the plywood board should be marked in degrees at intervals of 10, as indicated in the drawing. Paint the center pin and the two targets white and the remainder the device any dark color.

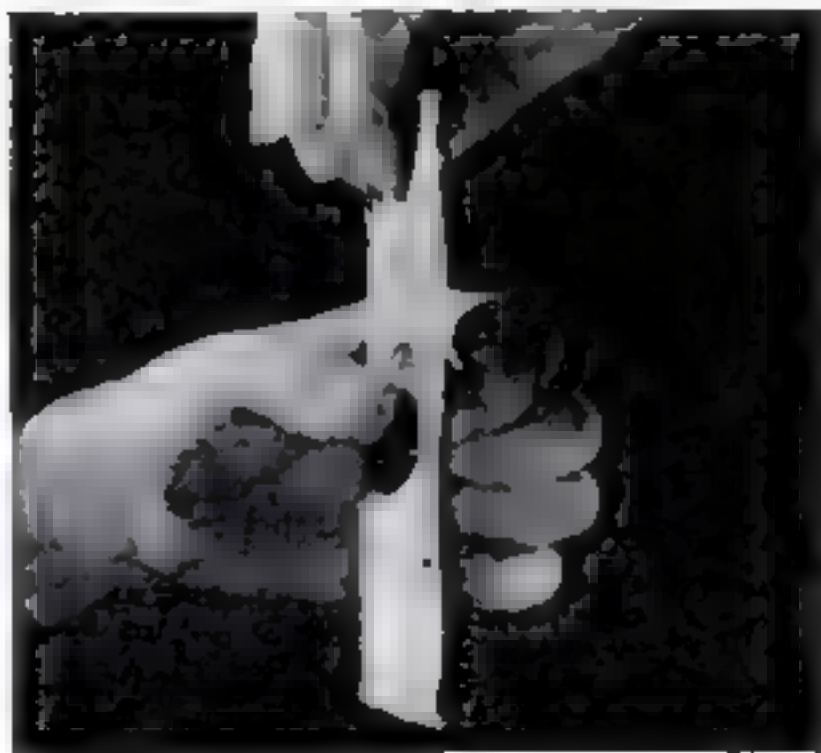
The contestant is required to press his nose into the notch and keep both eyes focused on the reflection of the white pin in the mirror. The person applying the test stands back of the board with both hands under it so he can move one or the other control wire without letting the contestant know which. At the moment the contestant notes out of the corner of his eye a movement of one of the targets, he should call out, saying whether it is the one at the left or the right, and at this



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point the degree mark beside it is noted.

Allow one practice trial on each side. Then make two actual tests on each side in random order and total the four scores. From 430 to 440 is excellent, 410 to 429 good, 390 to 409 average, 370 to 389 fair, and below 370 poor.



Neat Stunt with Dollar Bill Will Test Your Reflexes

Do you think you are quick at grabbing a dollar bill, or does money slip through your fingers? Here's a stunt to try on yourself and your friends. One person holds a crisp dollar bill at one end while another places a thumb and forefinger on opposite sides but not quite touching, and attempts to catch the bill when it is released. It is surprising how fast you will have to be to succeed. Start with the fingers at the center of the bill. If you are too slow, try nearer the bottom.

ROBOT BOMBING GAME

By CARL W. BERTSCH

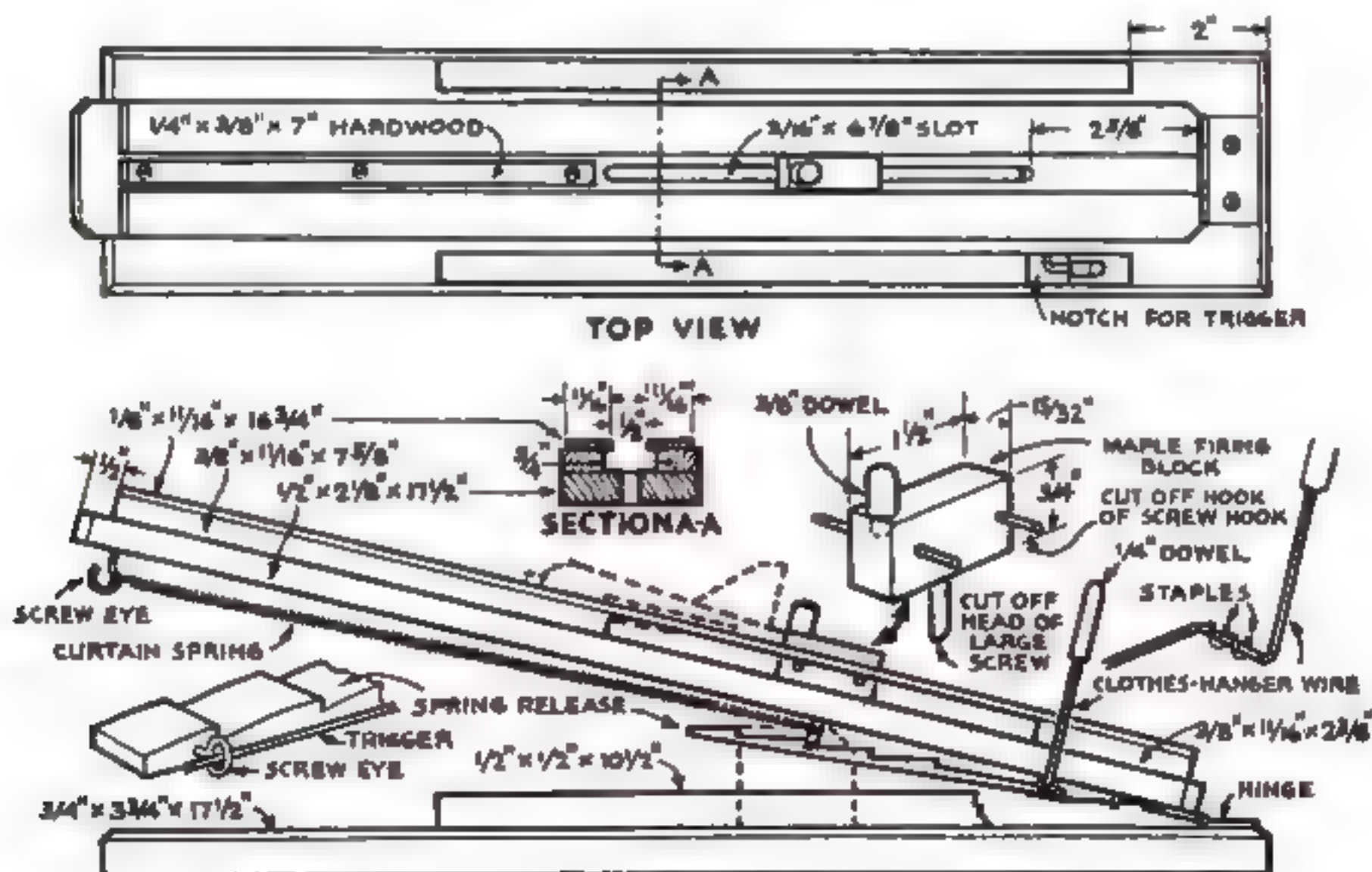
"SEVEN enemy flat-tops sighted 80 miles off the coast!"

Up goes the catapult, range and elevation are set, the firing block is pulled back, and an aerial bomb is slid onto the runway. "Ready . . . Fire!" The trigger is sprung and away goes the bomb, to fall among the seven black targets. If it strikes one between the white lines, the aircraft carrier is considered sunk and taken by the player who scored the hit. If any other part is struck, the target is damaged but not sunk. Three hits are required to eliminate it. Whoever scores them first takes the target. The player taking the most targets wins this fascinating game of robot bombing.

Each bomb is tipped with a rubber pencil eraser. Chalk, a different color for each player, is rubbed on the eraser. When the bomb strikes, it leaves a colored mark on the black target, identifying the player.

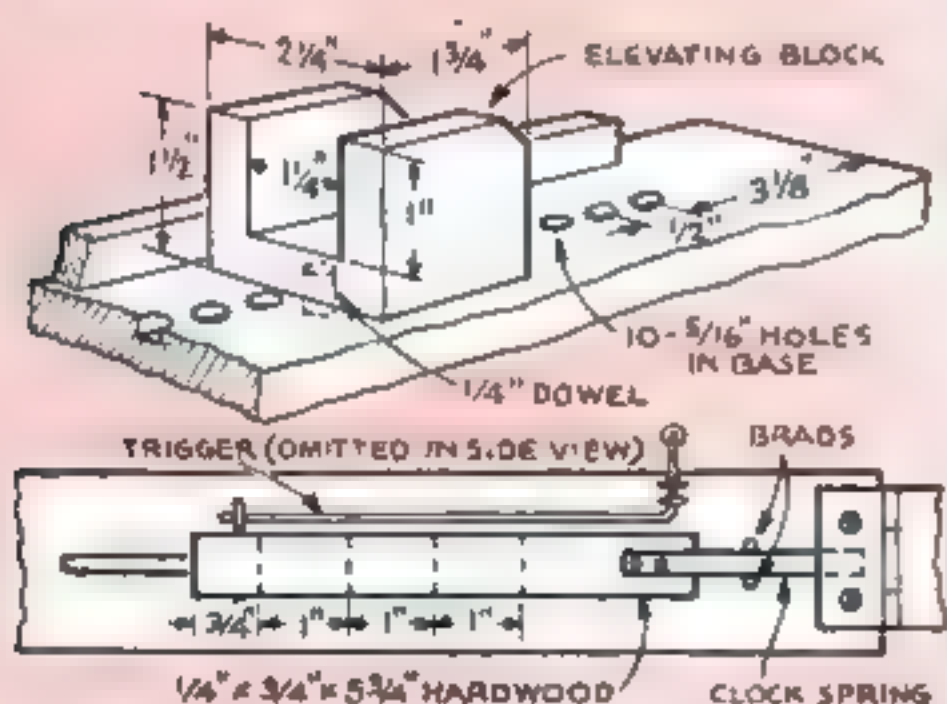
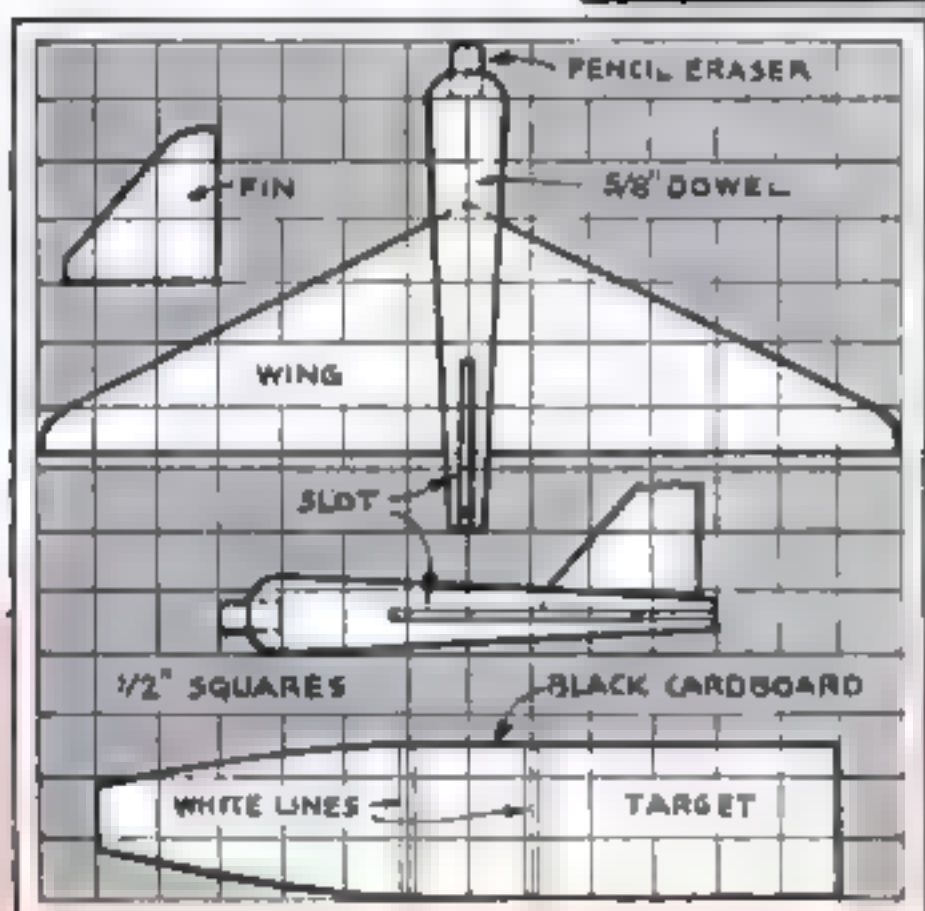
The base consists of a $\frac{3}{4}$ " by $3\frac{3}{4}$ " by $17\frac{1}{2}$ " piece in which 10 holes are drilled $3\frac{1}{4}$ " from one end. Two $\frac{1}{2}$ " by $\frac{1}{2}$ " by $10\frac{1}{2}$ " strips are nailed along the edges 2" from the same end and $2\frac{5}{16}$ " apart.

For the runway, cut a slot $\frac{3}{16}$ " by $6\frac{7}{8}$ " down the center of a piece of stock $\frac{1}{2}$ " by $2\frac{1}{2}$ " by $17\frac{1}{2}$ ". Nail a $\frac{1}{4}$ " by $\frac{3}{4}$ " by 7" hardwood strip just beyond the end of the slot, as shown in the drawing. Two $\frac{3}{8}$ " by $11/16$ " by $7\frac{5}{8}$ " strips are next nailed on either side of this one, and two pieces $\frac{3}{8}$ " by $11/16$ " by $2\frac{1}{2}$ " are nailed on behind the opposite end of the slot. All the outer edges of these four pieces should be flush with those of the slotted member. Atop these fasten with brads two strips $\frac{1}{2}$ " by $11/16$ " by $16\frac{3}{4}$ ". As shown in the sectional view, these are not flush with the outer edges of the other pieces, but are offset toward the center so that their inner edges are $\frac{1}{2}$ " apart.





Bomb away! Released from the launching catapult, the robot flies in an arc to dive on the cardboard "carriers" that are its targets. A player behind the table is holding one "sunk" by a previous hit



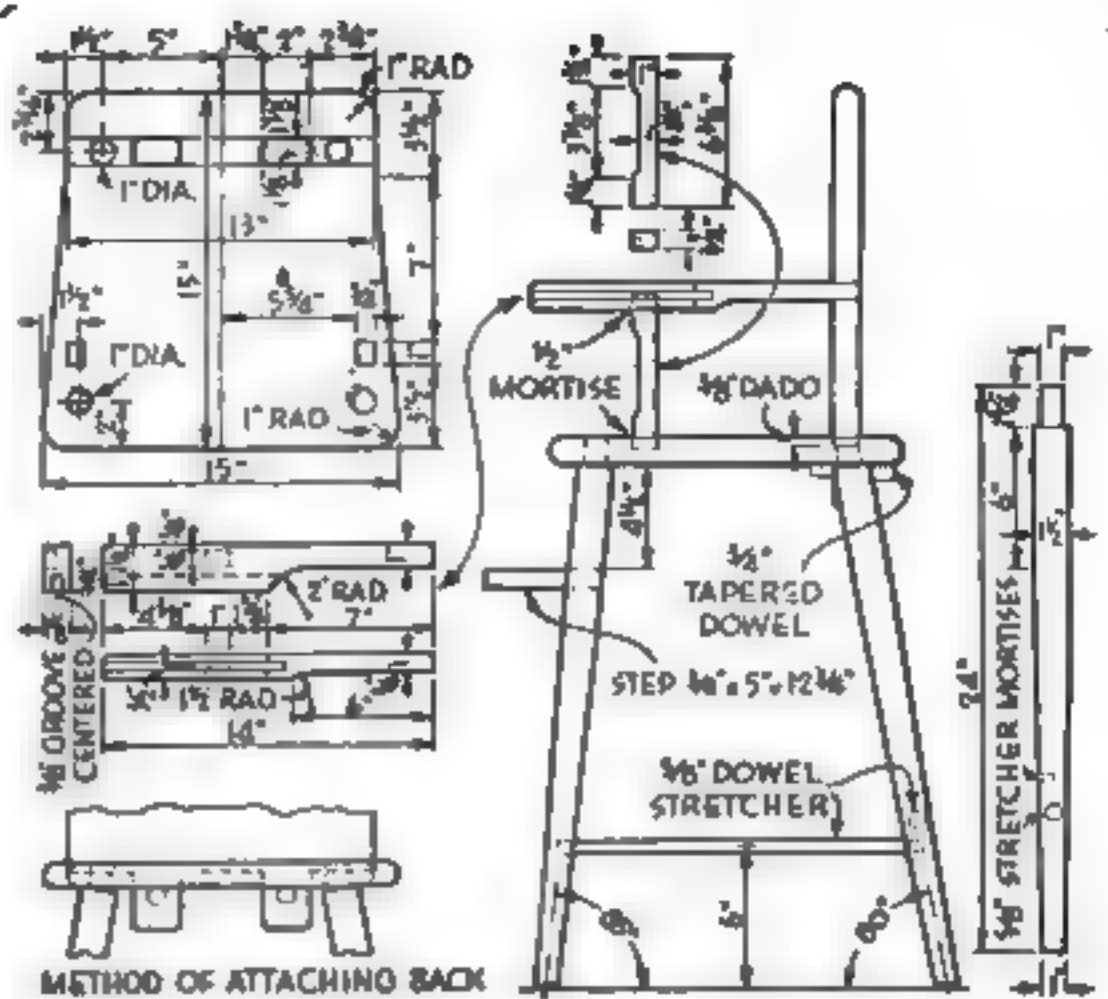
UNDERSIDE VIEW OF SPRING RELEASE

Make the firing block out of hardwood such as maple. Drive in a large wood screw cut off the head, and file the end at a slight bevel as shown. The stud so formed may be notched for the spring if necessary. Drill four holes in the sides of the firing block for ordinary screw hooks, place the firing block in the runway slot, and turn the screw hooks in. Finally, cut off the hook portions.

Cut a piece of curtain spring to a length that will be fairly taut when the firing block is at its extreme forward position, and attach it as shown. The trigger pivots on two staples and engages a screw eye at the end of the spring release, which is mounted on a piece of clock spring clamped under the hinge on which the runway is mounted. To bore holes in the clock spring for the mounting screws, heat it cherry red and let it cool.

The robot bombs are $3\frac{3}{4}$ " long pieces of dowel, turned or carved to a taper and slotted for cardboard wings and fins. Glue an eraser into a hole in the nose of each. Paint the bombs in bright colors with enamel, and the catapult a warm gray. Do not paint the top of the runway or the firing-block slide. The targets are cardboard painted with poster colors.

The four spring tensions afforded by the notches in the spring release provide ranges of from about $4\frac{1}{2}$ ' to 18' when the catapult is on the floor. The range for each position of the elevating block at various spring settings may be marked on the catapult for ready reference.



HIGH CHAIR FOR YOUNG DINERS

By Lawry Turpin

COMFORT and safety for the child and ease in cleaning for the mother are the chief requirements for a high chair in which a little one first sits at the family table.

The wide angle formed by the sturdy legs of the chair shown will keep it from tipping over even when its occupant won't remain still, while the strap from the seat to the tray and the hook and eye locking the tray to the arm keep a child from falling out. Being adjustable, the sliding tray can be set at a comfortable distance through all the years the chair is in use.

Rounded inside corners make it possible to clean up spilled food with a damp cloth. When necessary, the tray can be removed entirely and taken to the kitchen sink for a thorough washing.

In addition, the sturdy construction and the attractive carved squirrel design should put the piece in the heirloom class, for it will stand rough usage from many generations and will retain its appeal as long as children like animals.

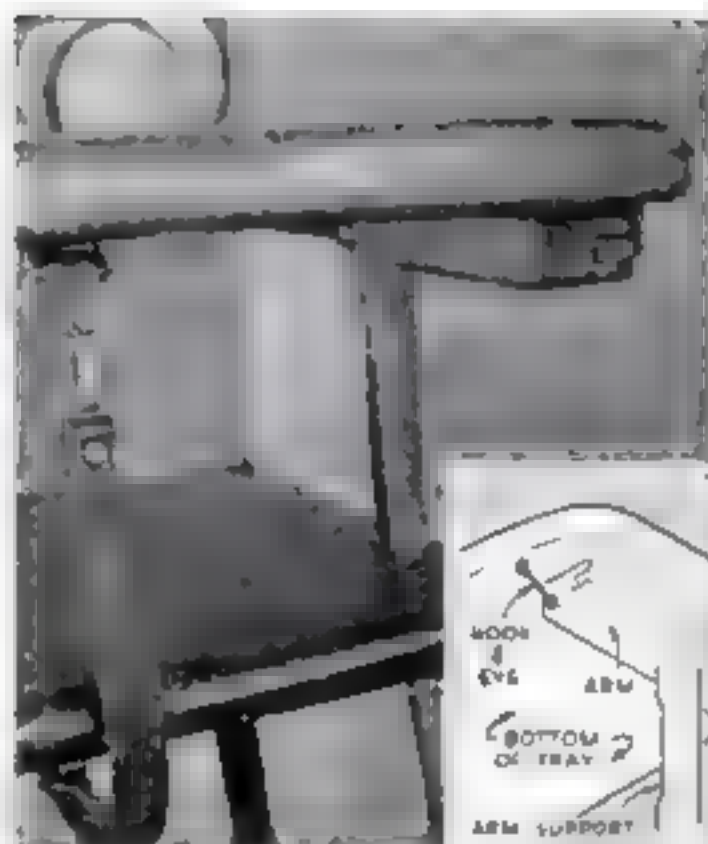
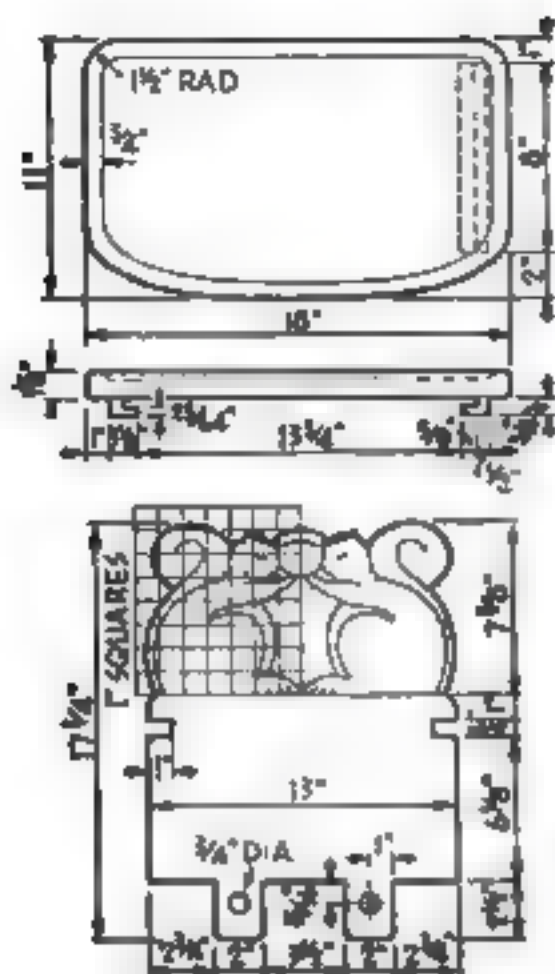
Use 1 1/2 inch stock for the back, seat, arms, and tray, 3/4 inch stock for the arm posts and footrail, 1 1/2 inch diameter turnings or maple dowels for the legs, and 5/8 inch dowels for rungs or stretchers. Pine, maple, or a combination of the two will make a handsome, serviceable chair that will take a hard finish of alternately rubbed coats of boiled linseed oil and shellac. Both woods are suitable also

for paint, oil stains, or wood dyes. If the linseed-and-shellac finish is desired, rub small areas at a time until the required hardness is attained, and put on a final coat of waterproof varnish, rubbing this down with pumice and oil.

The back may be cut out on a bandsaw, or a satisfactory job may be done with a hand scroll saw. The acorn and the squirrels are then carved. All edges above the arms should be well rounded. The piece is joined to the seat with two key mortises and tenons, as shown in the drawings, and it also fits into a 3/4 inch deep dado cut across the back of the seat. After holes for the leg tenons have been drilled to the proper angles and mortises cut for the arm posts, the seat is rounded at the edges, particularly at the front. It may be carved slightly concave, if preferred, or left flat.

Cut the arms first to the shape shown for their top; then undercut the narrow section. The grooves for the sliding tray may be chiseled by hand if power tools are not available. After the legs have been tapered in the lathe or by rasp or drawknife, they may be slightly flattened, if this style is desired, by planing on four sides.

Be sure to use a good grade of wood glue, preferably waterproof, in assembling the chair, for it will have to stand many washings. Glue the legs firmly to the seat first, drive a hardwood wedge into the tenon of each, and glue in the footrail and three rungs. Clamp the pieces tightly and leave



Although a center strap of the proper length serves to hold the tray, a hook and eye beneath afford complete safety



The carved back, simple but effective, adds much to the attractiveness of the chair

them for 24 hours, after which the tenon ends should be chiseled off flush. Next, glue and clamp the arms to the arm posts; then, after removing the clamps, glue the arms into the back and, with one downward motion, set and glue the back and arm posts into the seat. Drive the tapered keys into place, and reclamp the whole assembly.

Gouge out the tray to a depth of $\frac{3}{8}$ ", being careful not to leave sharp inside corners that will be hard to clean. The slides are rabbeted strips, or lengths of molding will serve if the proper contour can be found. Toenail them in place, trying out the tray for smooth sliding action on the assembled chair before driving the nails home.

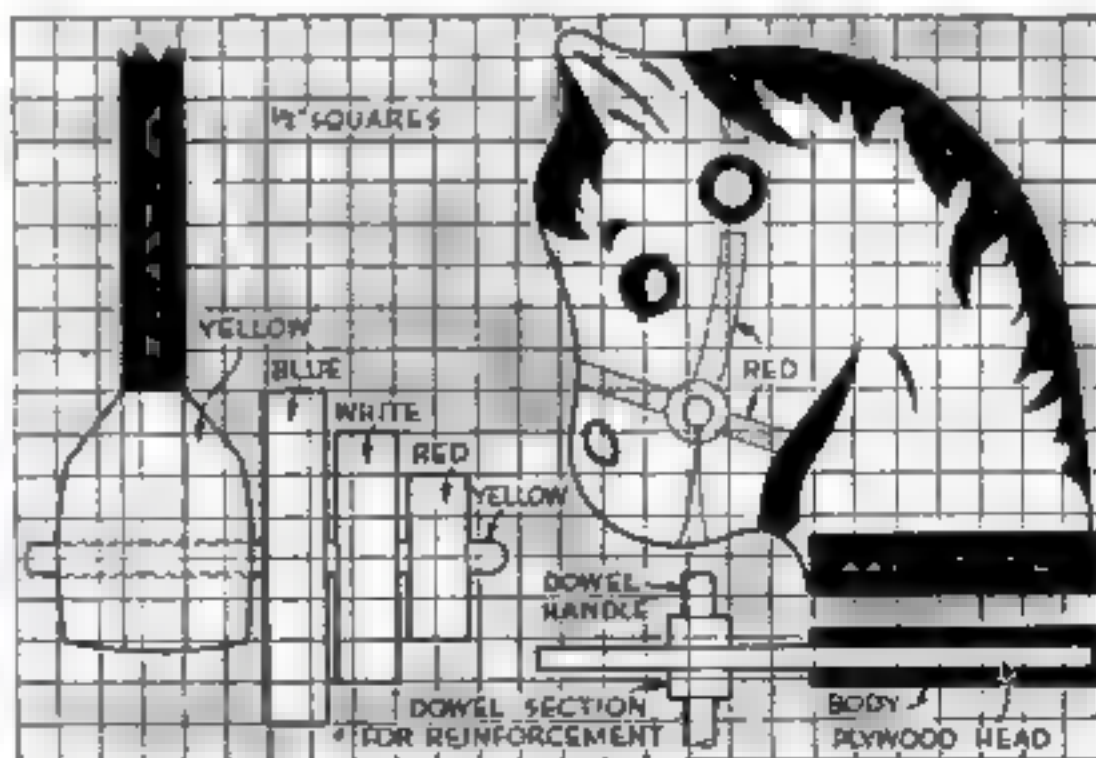
Hobbyhorse on Wheels Will Provide Fun for Active Boy

FOR his dally romps in the back yard, any boy will find this hobbyhorse a faithful companion. Cut a 36" length of $\frac{3}{4}$ " by $1\frac{1}{4}$ " stock for the stick, slot it for the $\frac{1}{4}$ " thick plywood head, and glue on to the other end two $\frac{3}{4}$ " by $1\frac{1}{4}$ " by $3\frac{1}{2}$ " strips shaped as shown. When the glue has set, bore a $13/32$ " hole in these strips and the body for a $\frac{3}{8}$ " dowel axle.

Saw out the head and drill a hole at

the end of the mouth for a press-fit $\frac{3}{8}$ " dowel handle 7" long. Glue the handle in, slip over each end a $\frac{3}{8}$ " length of $\frac{3}{8}$ " dowel drilled to fit, and glue these fast. Turn, or saw and file to shape, six wheels to the diameters shown, and glue them to the axle.

Sand all parts smooth. Paint them with the suggested colors or your own selection.—CARL W. THOMPSON, JR.





When you start canning Victory garden surplus this year, you may find you need to replace some equipment, and parts may be hard to obtain. If you lack a metal basket for immersing vegetables and fruits in boiling water, a bag made out of strong cheesecloth will serve as well.

No matter how careful you are funnels will rust out in time, especially at seams. If yours is no longer safe to use don't despair—you can cut one from a flattened No. 10 can, as shown in the drawing. For a bang-up job, solder it after rolling.



Hints for Victory Cannermen



If tongs are missing, the filled jars can be lowered into the cooker easily in a basket made of ordinary fence wire or still more simple, you can loop cord tightly around the necks



Some sort of grating is needed in the cooker to hold the jars off the bottom and let boiling water flow under them as well as around them; but the grate need not be metal—one nailed together from odds and ends of wood will answer the purpose.

At right is a pressure cooker that is entirely homemade. A General Electric transformer case that had been discarded was used for the body and lid, and the latter was drilled to take a pressure gauge. In use the lid is held with clamps.



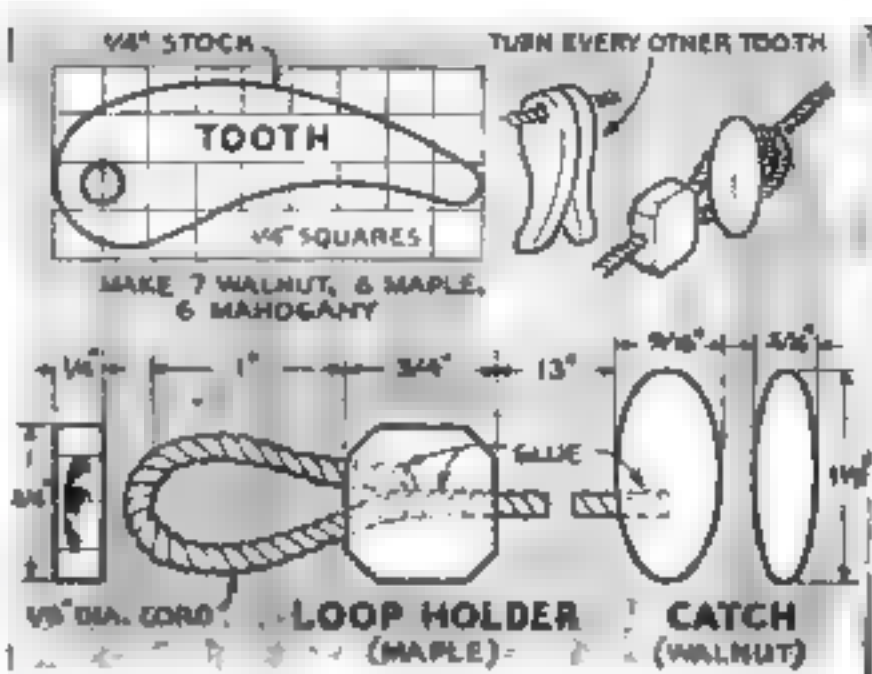
Even if you have no cooker at all, you can start from scratch and make a good one. The cooker shown above began life as a 5-gal. sirup can and already had the handle. Use a lid from a pot or cut one out of composition board.



Modern Necklace of Hardwood Scraps Follows African Design



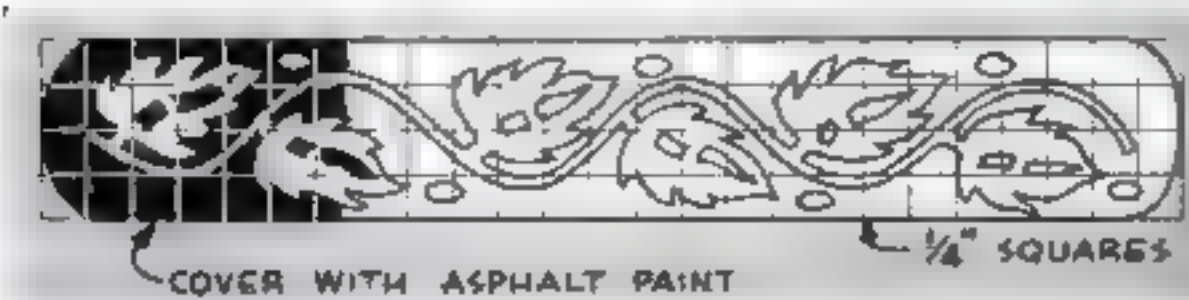
THIS attractive necklace resembling the lion's-tooth ornaments of African tribes is nevertheless distinctly modern. It is made by jigsawing $\frac{1}{4}$ " thick scraps of walnut, maple, and mahogany to the shape shown and boring each with a $\frac{3}{16}$ " hole for



stringing. Round the edges slightly with a file, and sand smooth; then apply two coats of clear lacquer and rub with steel wool to produce a luster. Seven walnut, six maple, and six mahogany "teeth" are strung alternately on a length of $\frac{1}{8}$ " twisted white cord stained a bright color with oil paint diluted with turpentine. Begin and end with walnut and turn every other tooth.
Make an oval walnut catch, as shown, boring a $\frac{3}{16}$ " hole part way through. Glue the cord in it. The loop is held in a hole bored through the edge of a $\frac{1}{4}$ " thick square of maple. Enlarge the hole at the loop end, and glue in the cord.—C. W. B.

Bracelets and Other Jewelry Etched with Simple Home Equipment

BEAUTIFUL work can be done on nickel silver with a stencil of black asphaltum paint and nitric acid diluted 1 part acid to 4 parts water. For the bracelet shown, cut out a 1" by 8" strip with metal shears, round the corners, file smooth, and finish the edges with emery cloth. Trace the design on the flat metal with carbon paper. Block out the stencil with four or five coats of asphaltum paint, as shown below, and coat the back all over.
Immerse the flat strip in the acid bath in a shallow glass dish, using tongs and taking care not to let acid touch skin or clothing. The etching will be stippled unless brushed gently. Always put acid in water, not the reverse. Do not dispose of it down a drain.—MICHELE DE SANTIS, JR.



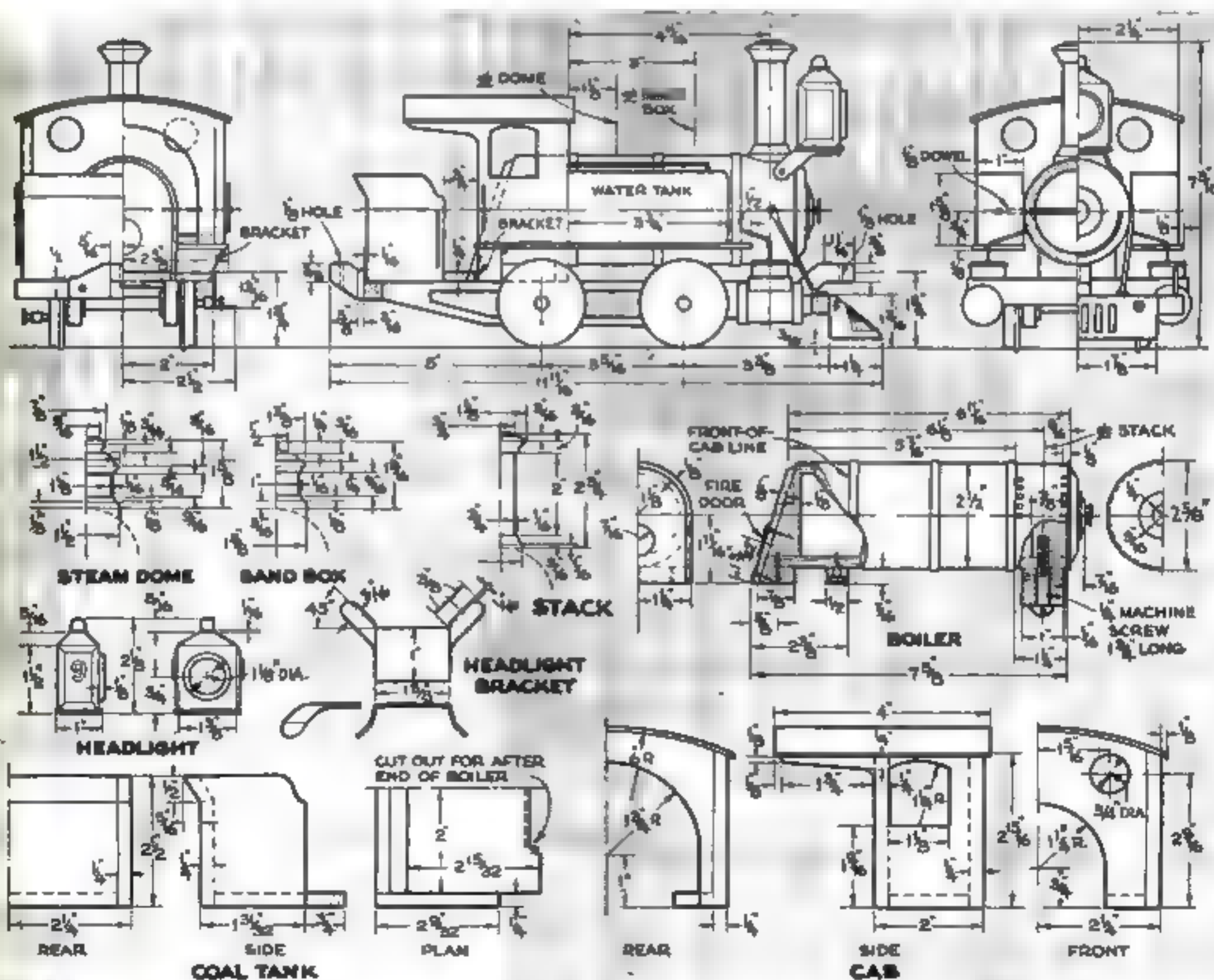
BY ALFRED D. SLATER

Using $\frac{5}{8}$ " dowel stock, turn the axles on the lathe. Slide them into the frame bearing holes, insert a $\frac{1}{8}$ " by $\frac{5}{8}$ " by $1\frac{1}{4}$ " spacer between each axle and the adjacent cross brace, and nail the spacers to the cross braces. Complete this assembly by gluing the wheels to the axles.

from $\frac{1}{8}$ " stock. Mount the side rods on the $\frac{1}{8}$ " diameter crankpins. Secure them to the forward pins with tacked-on celluloid disks. Put dowel spacers, as shown, on the rear pins, add the main rods, and tack on two more celluloid disks. For the moment, leave the forward ends of the main rods alone.

Cut the saddle, boiler foundation, cylinders, and steam chests to the right size, assemble them, and fasten them to the frame. Each cylinder has two holes. The upper one, $\frac{1}{4}$ " in diameter, has a guide rod glued into it.

Each wheel is made by centering the stock on a piece of wood that is fastened to the lathe faceplate, then turning the edge to form a flange. Axle and crankpin holes are bored and the spokes are cut out.



The lower one, $5/32$ " in diameter, provides a sliding fit for a piston rod. Both cross-heads have the piston rods glued into them and slide on the guides. Attach the forward ends of the main rods to them with $1/8$ " dowels.

A cardboard tube is used for the boiler. Put a filler piece in each end and nail the back head to the rear filler. There are two firebox foundations, as indicated, cut to fit under the after end of the boiler. The forward one is fastened with two screws, the after one with three screws that pass first through the rear cross brace. The front end of the boiler is tied to the foundation and the saddle with a machine screw.

Turn the steam dome, sand box, and stack on the lathe and hollow the lower ends to fit the boiler. Cut the headlight from wood and the bracket from sheet metal. Make the boiler front in the lathe.

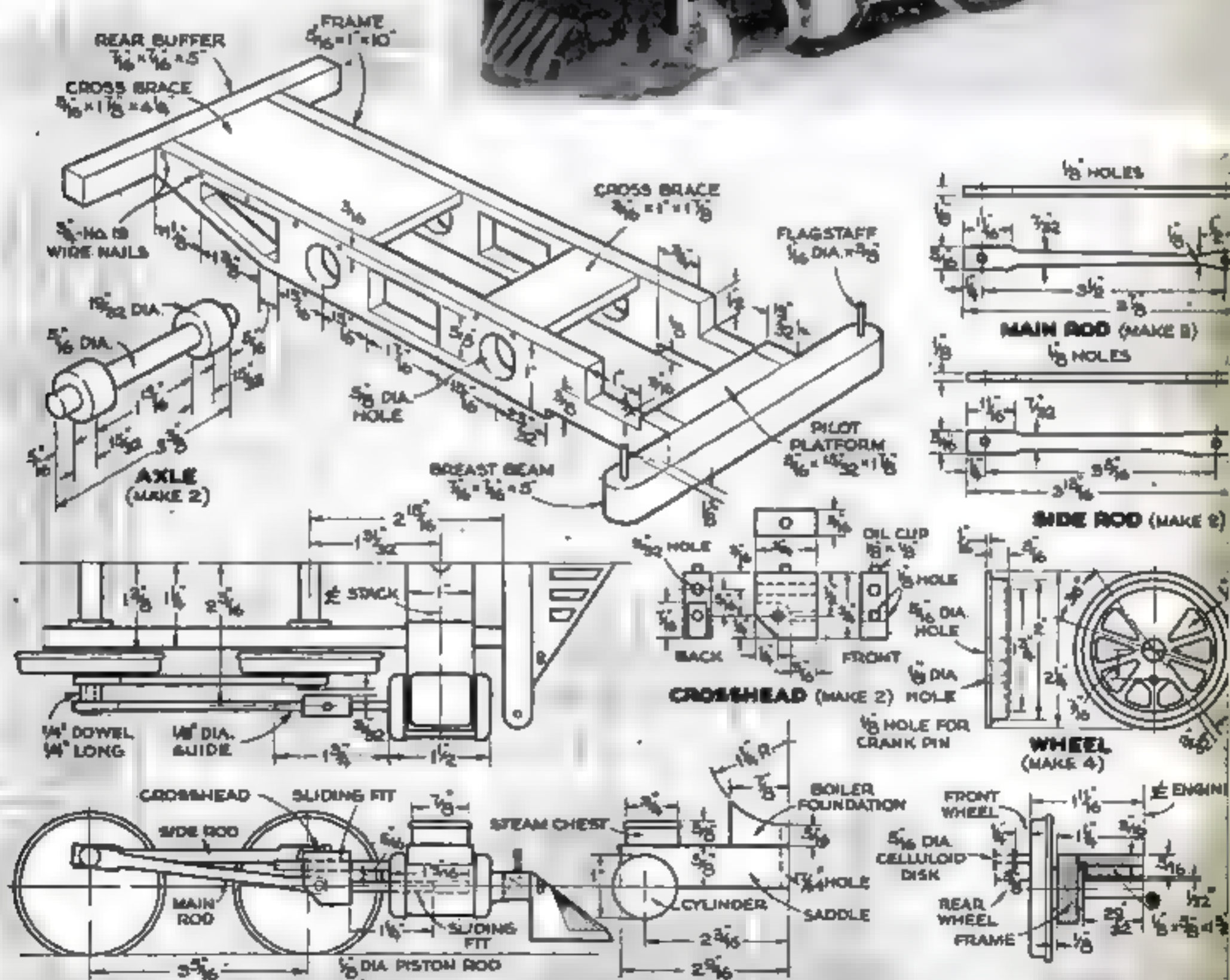
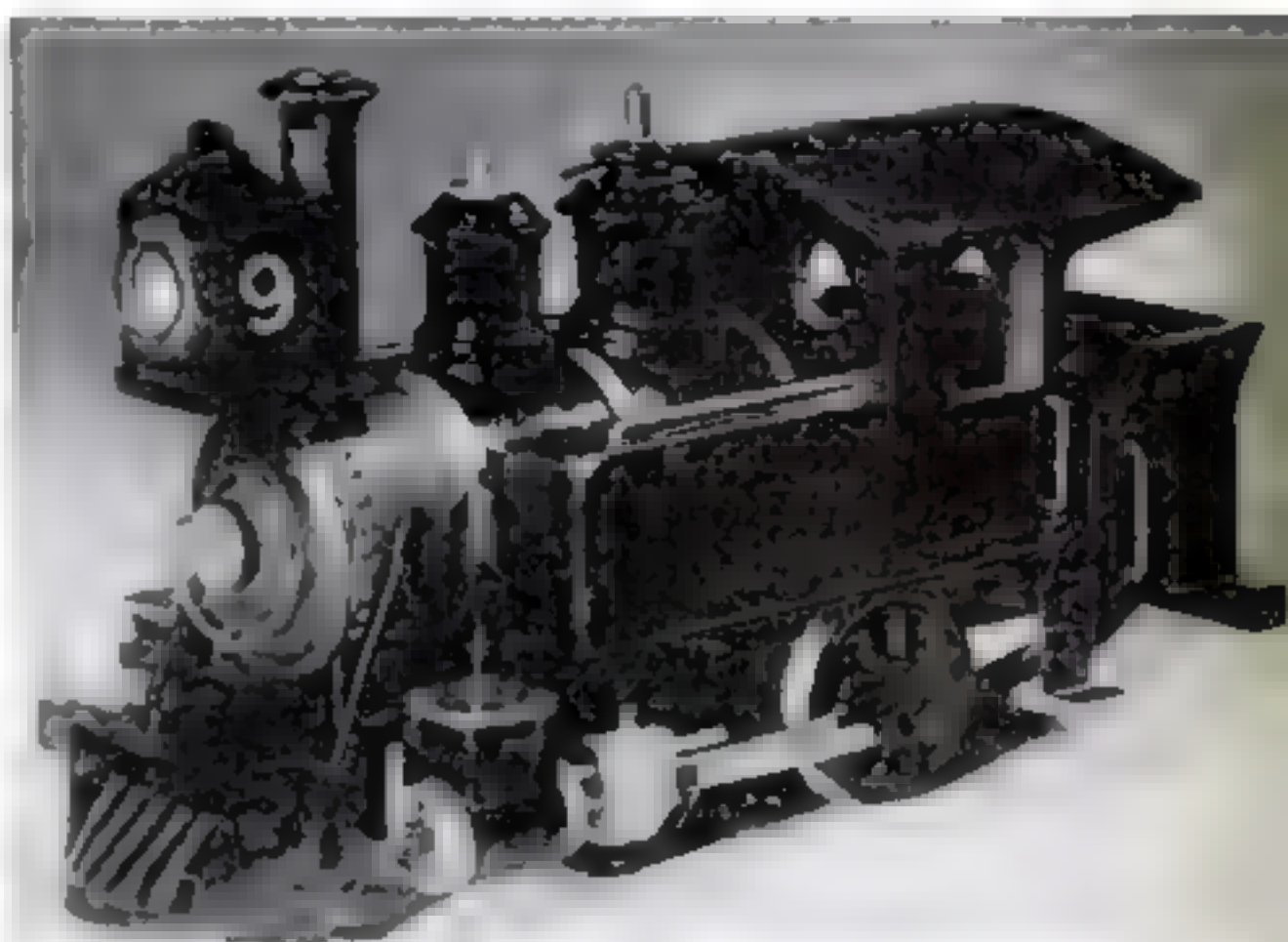
Running boards and solid-wood water tanks are as-

sembled next and held in place with two dowels, through the boiler and the firebox.

The cab and coal tank are plywood; the cab roof and the bracket between the coal-tank floor and running board are Bristol Board.

Make the couplers and cowcatcher of wood, gangway steps of tin, and pipes of wire.

Apply a black-enamel finish. Use aluminum and bronze paint for steel and brass.



OF INTEREST TO



HOME OWNERS

HOSE CLAMPS usually employ bolts, thumbscrews, or other intricate locking means, but here is a new one-piece clamp that may be snapped over the hose and latched by hand, as shown below at the left, then finally locked in place with a pair of pliers. It is made of SAE 1060 spring steel. By using it, low-pressure connections can be made for all sizes of standard hose. Tinnerman Products, Inc., of Cleveland, Ohio, is the manufacturer.



WEEDING WITHOUT BACKACHES in a tenth of the usual time is a claim made for this light, easy-to-handle victory hoe. Three sharp V-shaped metal knives slice through weed roots, cultivate the soil, and leave the proper dust mulch on top. The handle and wheels are made of wood. Complete, the unit weighs but 8 lb. It is distributed by Lewis & Conger, of New York City.

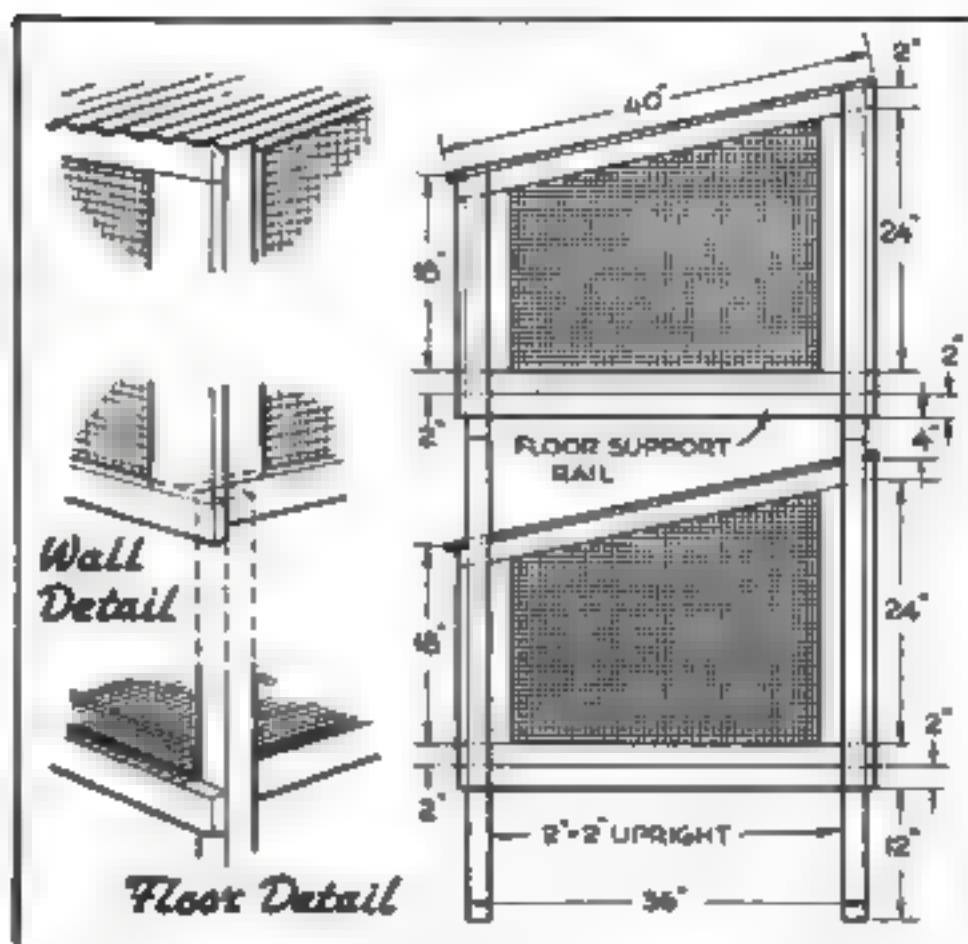


DAMAGED WALLS and woodwork are easily repaired with a new product which, unlike ordinary patching material, can be applied to old plaster, as shown at the right below, without undercutting or wetting to provide an anchor. The manufacturers, who also make Kem-Tone paint, claim that it does not shrink or crack, but adheres firmly to plaster, wallboard, brick, metal, and all painted surfaces.



PAINT REMOVER that not only softens the finish but quickly lifts it so it may be completely removed with a scraper is made by the Savogran Company, of Boston. The product, shown stripping paint from a door at the left, contains no acids, caustics, alkali, or benzol, yet it removes paint, enamel, varnish, shellac, lacquer, and synthetic resin finishes without resorting to the use of a blowtorch and without producing an unpleasant odor.





WIRED RABBIT HUTCHES built in movable banks of three with removable partitions are ratproof, weatherproof, and easily cleaned. Each hutch of those shown is 36" by 36" and, with the partitions removable, a bank can be used either as breeding cages or a run. Assembled in tiers of two, they take little space and are at a convenient height for tending the animals.

Since rabbits chew exposed wood, the self-

cleaning floors of $\frac{1}{2}$ " mesh hardware cloth and walls of inexpensive wire lath are attached from the inside. Sloping roofs of corrugated sheet iron protect the upper tier from rain and the lower from refuse dropped through the mesh floor.

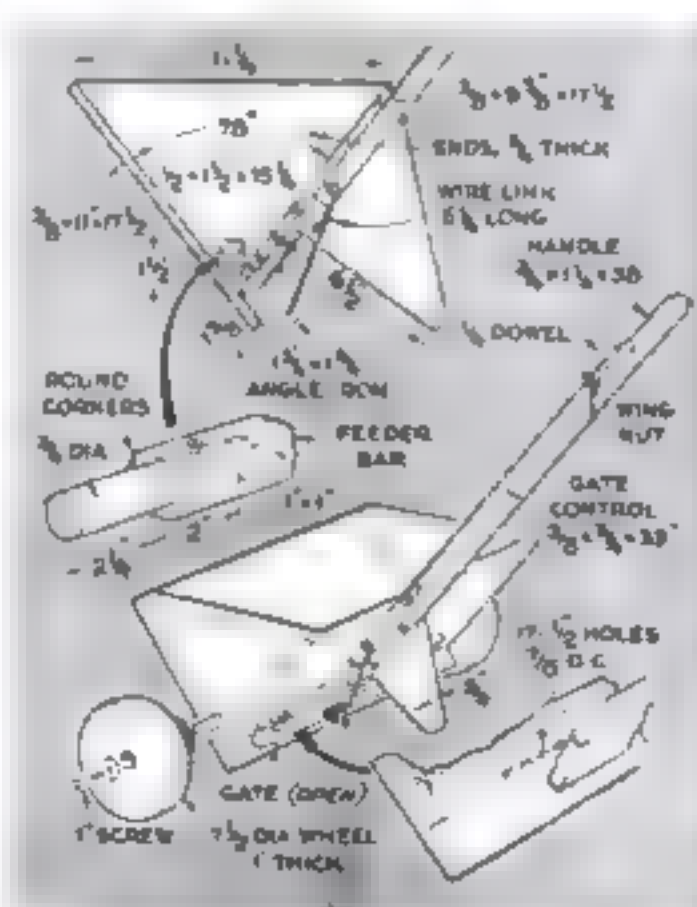
Nail kegs make good nest boxes. A 5" wide board across the front steadies them and keeps the young in until they are large enough to hop.—JONAS H. WOOD.

THIS GARDEN SPREADER made entirely of wood is an efficient distributor of fertilizer and seed for a lawn or garden. In some respects wood is superior to metal for construction because it resists acid.

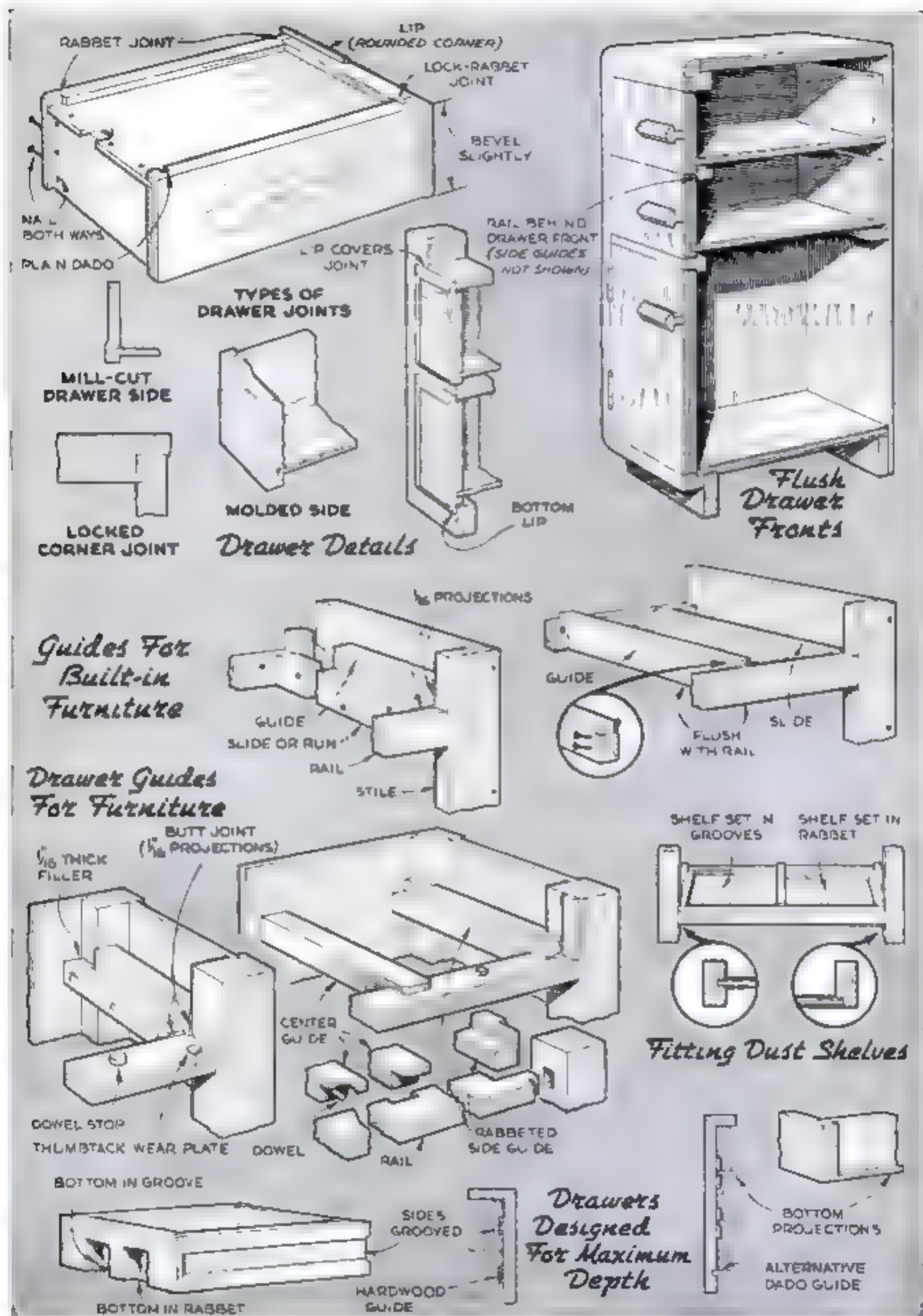
Plywood is excellent for the hopper. If solid wood must be used for ends, reinforce the axle holes with a little sheet iron, since there is not much stock there. Use hardwood for the feeder bar, which also serves as the axle, and turn tenons on it or fit it with two dowels to revolve in the axle holes and hold the wheels.

Fertilizer or seed is distributed through a row of $\frac{1}{2}$ " holes $\frac{3}{8}$ " from the bottom edge of the back. A hinged gate connected by a small angle iron and a wire link to a sliding strip on the handle opens and closes them. This control strip is slotted to slide on two bolts, the upper of which has a wing nut for locking.—C. C. CONSTANCE.

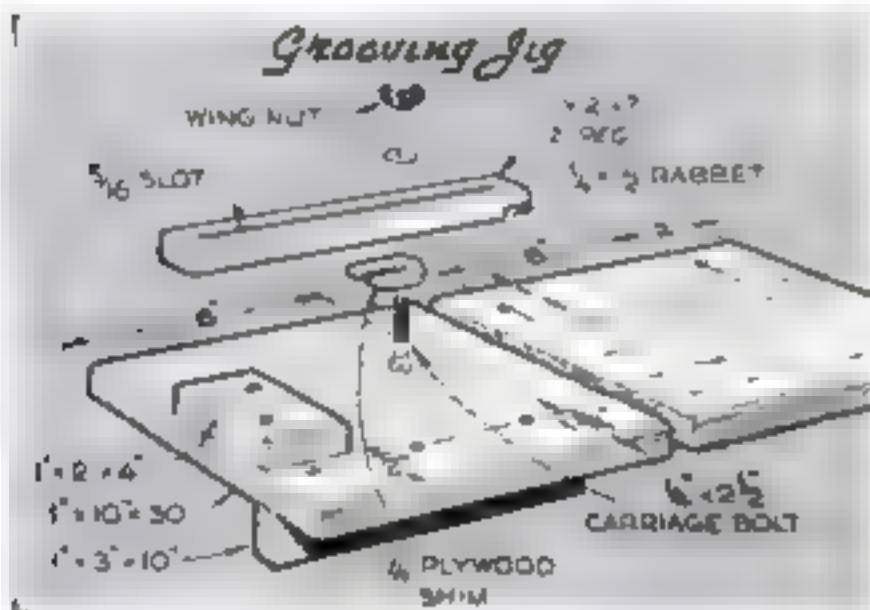
FRESH GREASE SPOTS can sometimes be removed from wallpaper with clean blotting paper and a warm iron. When this fails, the New Jersey State College of Agriculture advises trying a thick paste made of French chalk or powdered magnesia and water. Let the paste dry on the spots for 24 hours, and then brush it off carefully.



The ABC's of Good



Drawer Construction



By EDWIN M. LOVE

DRAWERS come in for hundreds of uses in our everyday life. They are pulled out and pushed back many times a day in the office, shop, and home. Often they are treated carelessly. And yet if drawers are carefully built, they will stand up for years, never sticking, never giving trouble.

There are many forms of drawer construction, and there are a variety of designs for a multitude of purposes and different kinds of furniture. It is practically essential that all woodworkers have an understanding of basic drawer construction as applied both to cabinetmaking and house carpentry.

What construction is most used? Drawers assembled with rabbeted corners and

with bottoms let into grooves are largely used for built-in cupboards and inexpensive furniture. Back joints are sometimes butted, glued, and nailed, but for general use this is not recommended. Glue seldom holds strongly to end grain, and it is difficult to nail joints when there is no shoulder to fix the location of the back.

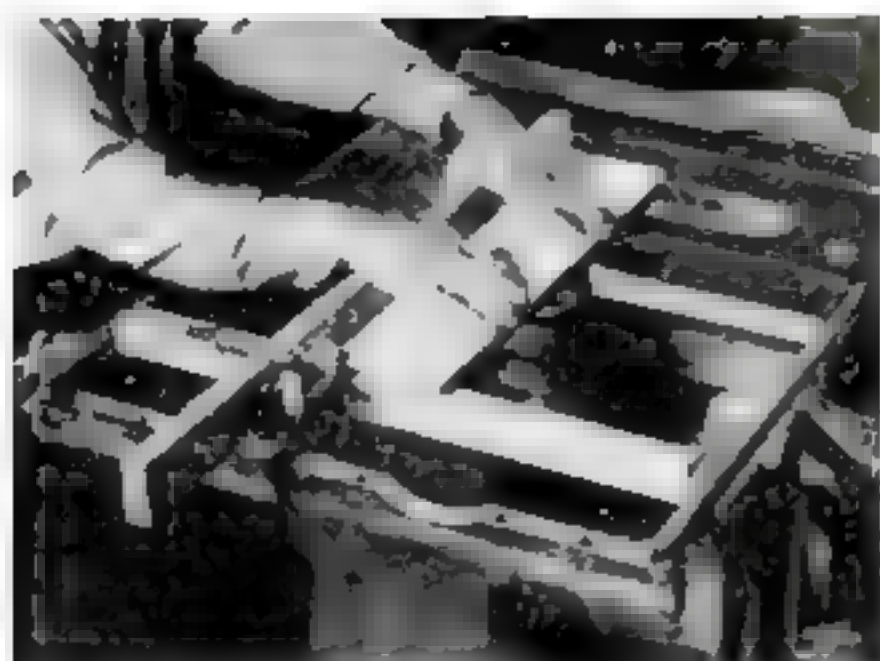
Rabbeted corner joints and grooves are easy to make either by hand or machine tools. First, size the stock and cut it roughly to length; then plow the grooves and, if the drawer is to have a lipped front, rabbet the upper or both the upper and lower edges of the front piece. Next, rabbet the ends of the front and the mating ends of the sides. Cut the back to length, and then nail the four pieces together.

Slip the bottom in, square the drawer, and drive two or three brads through the bottom into the back. If there is any bottom play, toenail brads into the front as well. When the back is grooved, assemble the bottom with the sides before adding the back.

Can binding be prevented? Much binding is caused by cupping of the sides of closely fitted drawers. Some sides are milled with a raised strip along the bottom to lessen the effects of warping. Deep drawers bind at the top and bottom because of swelling of the sides, and ample clearance must be provided in the cabinet frame.

Sticking is also caused by improperly fitted guides. Whether side or center guides are best is a moot question. My own preference is the center guide—a slender bar in the frame sliding between strips on the bottom of the drawer, or a milled hardwood toe sliding in a grooved member. Pressure applied at one end of a drawer front twists the drawer between side guides, often causing it to jam. This effect is greatly reduced by the center guide, which also permits wide side clearances. Center guides are a necessity for odd-shaped drawers such as triangular ones in parts cabinets of hexagonal shape. Two such guides often improve the working of wide drawers.

How are guides installed? Center guides extend between the front rail and back of the cabinet. Butt and dowel the ends, or notch the fronts over and into the rails. A toenailed butt is generally used in built-in cabinets. The front end acts as a drawer stop, while the lower edge is flush with the underside of the rail and serves as a hold-down for the drawer below it, keeping its front from dropping when the drawer is



Ends of drawer fronts are rabbeted accurately in a setup like that shown above. Part of the stop reaches under the first rabbet and gauges inside dimensions. Below, guide strips go on a drawer bottom with brods slanted into the front and back



open. Top drawers, of course, need a separate hold-down.

Square each guide from the front rail and be sure it is parallel to the guides above and below. Insert a drawer and, using the sides of the guide as a gauge, scribe lines on the bottom for placing the strips. Little sliding clearance is needed. Construction is improved if slides or runs are installed at the sides of the cabinet to relieve the guides of most of the weight of the drawer.

Methods of installing side guides are also shown in the drawings. If these guides are allowed to project $1/16$ " beyond the rails and stiles where this is possible, much wear will be prevented. Heavy drawers require a greater projection.

What is done in fitting drawer fronts? After the guides have been installed and the drawer otherwise completed, insert it in its opening and dress the ends and top until the front will enter. Pull the drawer out again and bevel inward slightly, continuing the fitting until a uniform joint of about $1/16$ " is obtained. This provides space for several coats of paint or varnish.

Fitting such as this requires the use of closing stops. Dowels inserted in the lower



After 20 years of service, all the drawers in this cabinet still slide smoothly and close perfectly

rail and filed or chiseled in front to allow the front to be pushed back into place are excellent for drawers having side guides. Hardwood strips tacked until adjusted and then nailed or screwed permanently are also good. If drawers are set back behind the edges of the rails, the stops must be set back correspondingly.

Lip drawers, having fronts with rabbeted top and side edges that lap over rail and stiles to conceal the joints, require little fitting. Side clearance is also less critical than with flush fronts. Close the drawers and lay a straightedge across the fronts to mark the ends for cutting to length. The lips customarily act as stops, but for drawers subjected to abuse, such as equipment drawers in manual-training shops, stops may be placed behind the drawers to take the shock of closing off the fronts.

How is maximum depth provided? To add to the depth, eliminate rails between the drawers, and groove the sides of the drawers to slide on guides on the sides of the cabinet. For still more space, set the drawer bottom in a rabbet or screw a plywood bottom to the lower edges of the sides, projecting it to slide between the side guides.

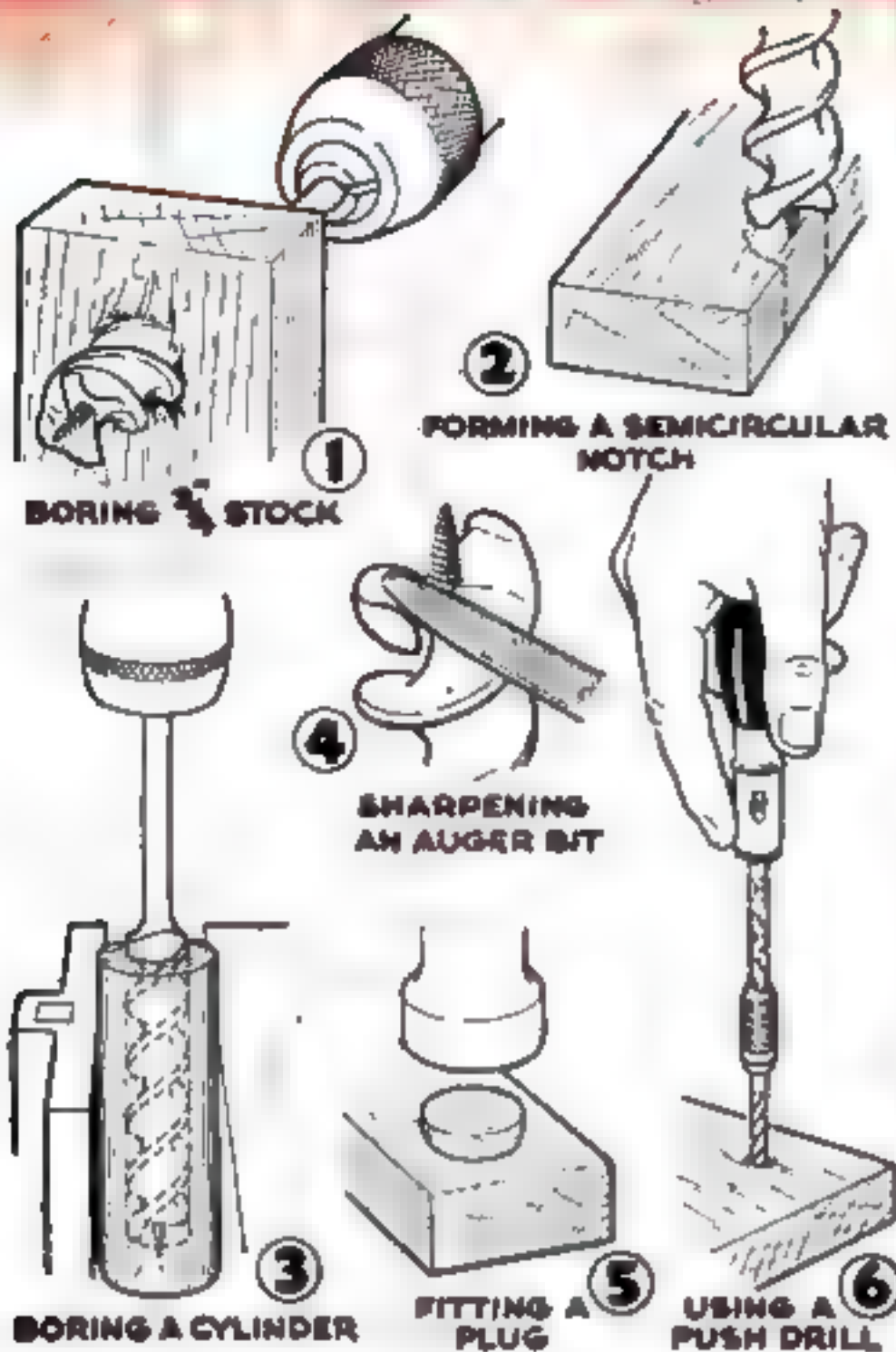
What is required for dust shelves? Groove the rails and slides to take the edges of dust shelves, or rabbet them to hold the shelves flush with the lower edges. Flush shelves leave no projections to catch on contents of drawers beneath them.

What's Wrong?

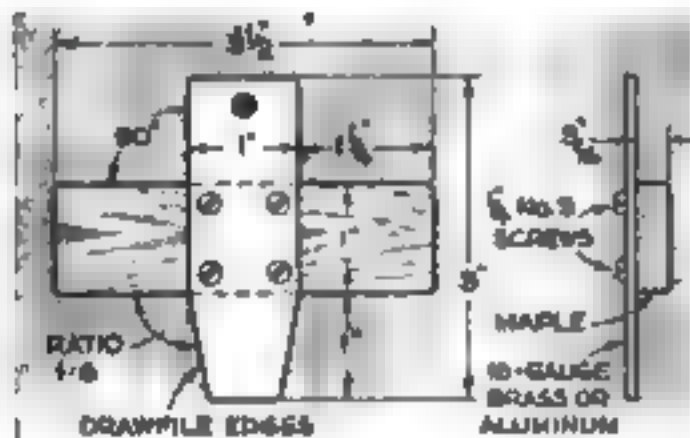
AN ERROR that no experienced woodworker would ever commit is being made in each of the six drawings at the left. How good a woodworker are you? To test your knowledge, study the drawings carefully and write down the six mistakes that you think are being made. Then turn this page upside down and compare your answers with the correct ones given below.

1. To prevent splintering of the far side, the bit should be taken out as soon as the point pricks through, and the hole finished from this side.
2. A point so close to the edge will split out. Use a scrap block clamped to the edge to hold it.
3. Bore holes in wooden cylinders half-way through from each end. It is almost impossible to bore all the way through and come out at the center.
4. An auger bit should be filed on the upper side of the cutting lip, not on the lower side.
5. Always drive plugs in with the grain parallel to that of the work.
6. A twist drill cannot be used in a push drill. It requires straight-fluted drills.

ANSWERS



Special T-Square Speeds the Laying Out of Dovetail Joints



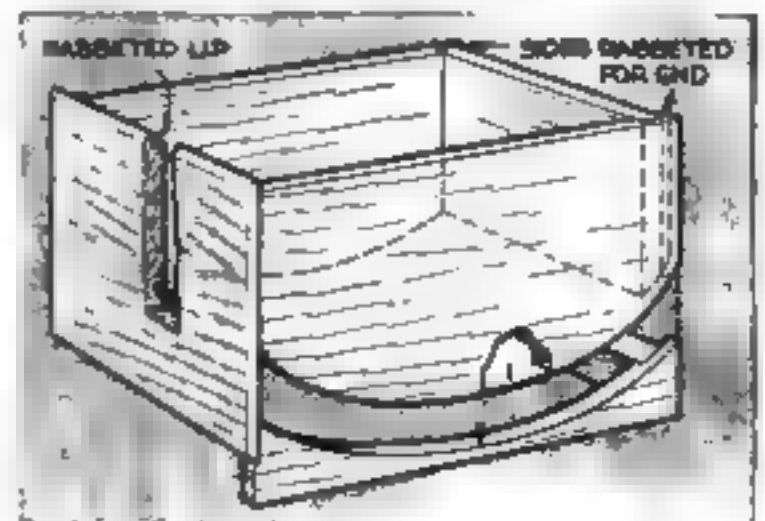
For this square you need a 1" by 3" piece of 16-gauge brass or aluminum and a 5/16" by 3 1/2" piece of maple or other hardwood. These dimensions are finished sizes. File one end of the metal arm to the shape shown in the drawing. Square off the wooden handle all around and fasten it to the arm with four 1/4" long roundhead wood screws.

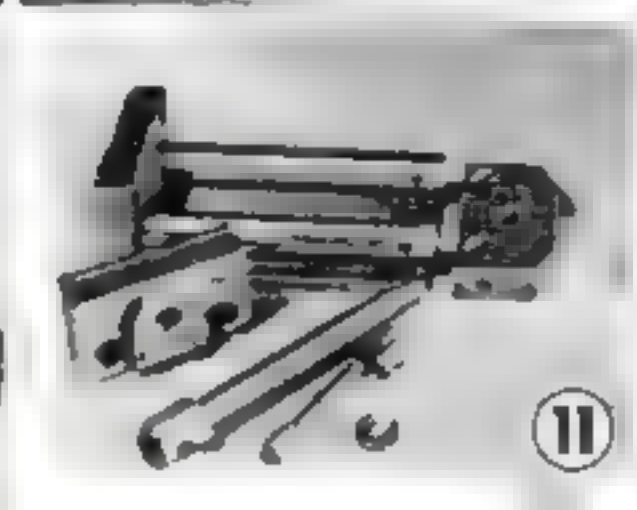
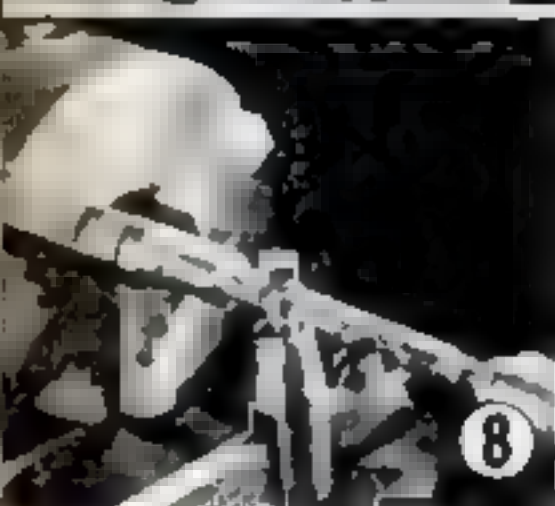
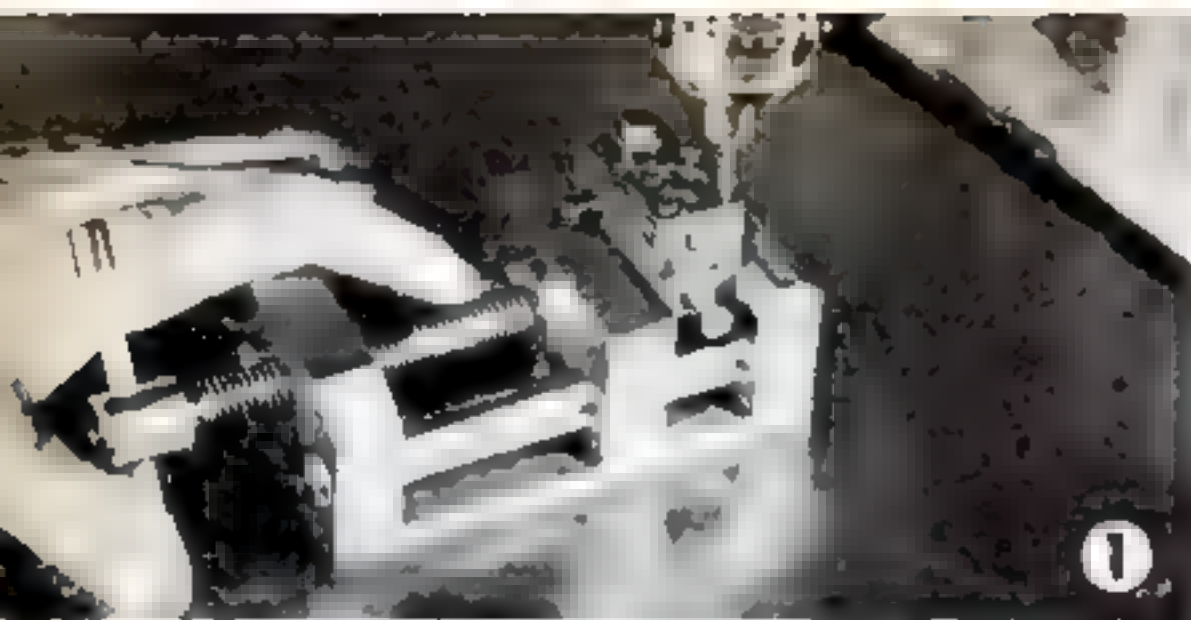
Space off the dovetails and pins on the stock to be cut (see P.S.M., April 1944, p. 151); then use this square, instead of a bevel square, as a guide for marking the cuts.—E. CARLYLE LYNCH, JR.

Kitchen Drawer for Bread and Cake Made with Curved Bottom

MAKE up front, back, and sides of this drawer as for an ordinary one, but instead of grooving the sides, mark them with penciled curves and cut them out, preserving the waste. A hand rip saw is satisfactory if a power saw is not available. Rip the back at a bevel following the line of curve, and assemble the wide parts.

Next, guiding the saw on the curved edges, rip a kerf 1/4" deep in the front. Cut the tin to size, insert one end in the kerf, bend it around the sides, and brad the edges. Finish by nailing the waste pieces in place.—E. M. L.





BUILDING A DRILL-PRESS VISE

By C. W. Woodson

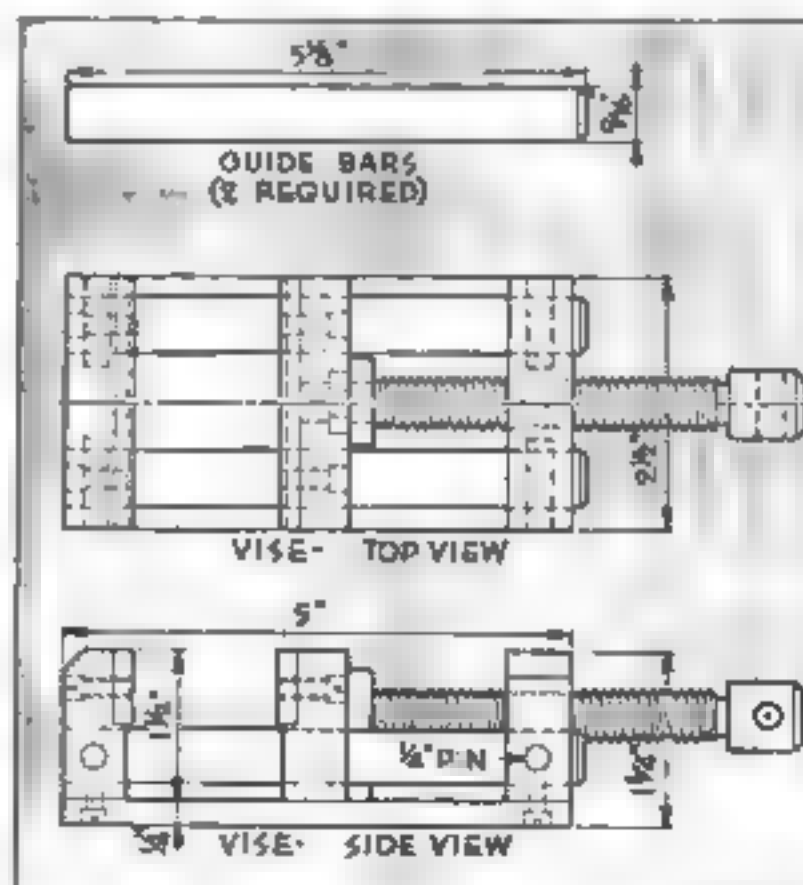
DESIGNED especially for the home workshop craftsman who likes to make his own equipment, the drill-press vise shown in Fig. 1 is an interesting tool to construct, and an exceptionally useful one.

It is built entirely from short ends of cold-rolled steel such as can be found in small machine shops. Dimensions can be changed to suit the stock. Those shown are for a vise with a capacity of 2½" between jaws.

Since smooth operation is essential, the holes for the guide bars must be drilled accurately. Make the guide bars first, cutting 9/16" steel rod to length, squaring the front-jaw end, chamfering the other, and polishing with fine emery cloth.

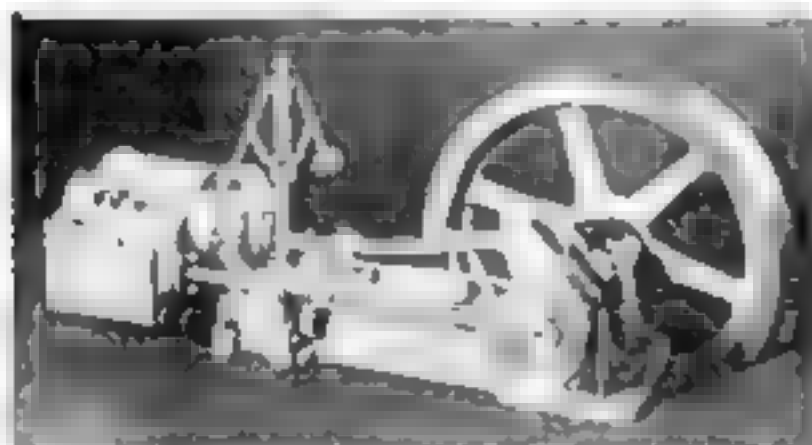
Cut the three steel blanks for the jaws and end bracket to length and machine them square and smooth in the shaper; then carefully stack the blanks, clamp them, and lay out and center-punch the guide-bar holes. Mount the clamped blanks in the drill press, drill the holes slightly undersize, and ream one to final size. Fit a guide bar in this hole and ream the other, as in Fig. 2, while the blanks are still clamped.

If the work is set perfectly level for both drilling and reaming, the



Meet C. W. WOODSON

Commercial artist by trade, this regular contributor of articles on metalworking makes his own photographs and working drawings. He lives with other artists, engravers, printers, and craftsmen in East Aurora, N. Y., near the Elbert Hubbard Roycroft colony. After a youth spent in Canada, where he married, he returned to his native U. S. A. Now 49, Woodson has cut out riding wild horses and other hard sports. He is an old hand at sailing and has built ship models. At one time, he specialized in woodworking and fine cabinetmaking, but a dozen years ago he turned to metalworking. Being comparatively new at this, he says modestly, he appreciates the problems of the beginner and attempts to help him. He does this admirably in his POPULAR SCIENCE articles



Woodson confesses his first love is steam engines. He is making a 1-ton locomotive for a 7 1/4"-gauge garden railroad. The model shown at the left is his pride. Note the other engines above his bench



holes will be accurately aligned and the blanks will move on the bars without binding; but to be sure they remain aligned on the base, take a light finishing cut across the bottoms while they are clamped in the shaper vise (Fig. 8) with both guide bars in their holes.

Locate on the rear fixed-jaw piece a hole for the vise screw, slip the guide bars in this and the movable-jaw blank, clamp, and drill a 3/8" hole through both. Mount the movable jaw in the lathe and center the screw hole accurately by inserting the tail-stock center, forcing the piece against the chuck face, and tightening. Counterbore with a sharp tool for the slotted washer, as in Fig. 4. Mount the end bracket the same way and open up the 3/8" hole with a 27/64" drill, and tap (Fig. 5) with a 1/2"-13 tap.

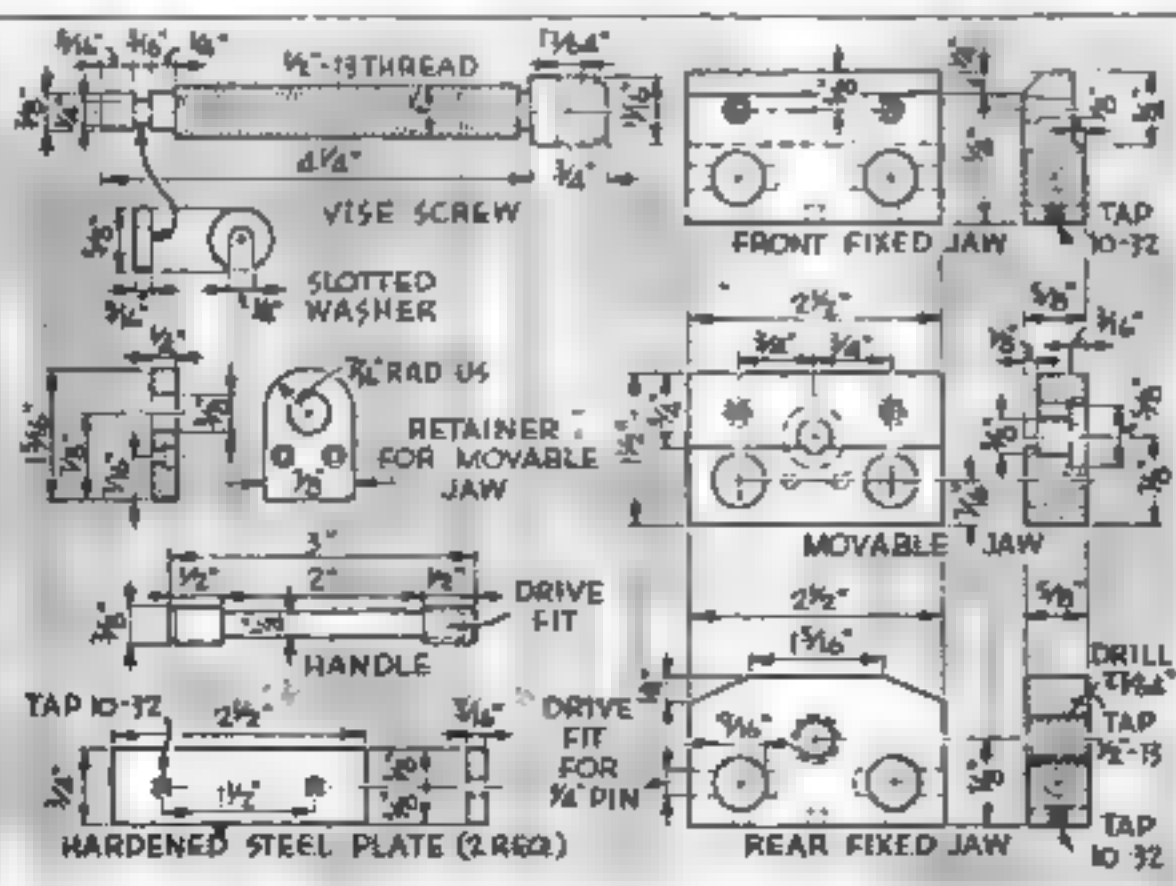
Bevel one top edge of the fixed jaw in the shaper and cut the corners of the end

bracket, as shown in the drawings; then rabbet the faces of both jaws for hardened steel plates, as in Fig. 6, being sure each blank is blocked up perfectly level and is held firmly in the shaper vise. These pieces are shown at this stage in Fig. 7 along with the base, a flat piece of cold-rolled steel cut to length and width and squared in the shaper. Make up the jaw plates from cold-rolled steel and drill them and the jaws for fillister-head machine screws, counterboring the jaws.

Turn the vise screw to the dimensions shown and thread it in the lathe (Fig. 8) with a sharp, properly ground and set tool bit. The washer is turned on the end of a bar, drilled, cut off, and slotted with a hacksaw. Make the sliding handle in the lathe and have the ends a drive fit. The retainer, for pulling the movable jaw back, is cut from bar steel. These pieces are shown in

Fig. 9 and, along with the movable jaw, in Fig. 10.

Drill the ends of the fixed jaw and end bracket for pins to hold the guide bars, and assemble the base, fixed jaw, and guide bars as in Fig. 11, pinning the bars in place. Slip on the movable jaw, screw the vise screw through the end bracket, and assemble it with the slotted washer and retainer in the movable jaw; then oil and try the parts and, when satisfied that all works freely, pin the end bracket and guide bars together.





Clamp Lathe Dog for Tapered Work

WHEN tapered work is to be mounted on centers in the lathe, this dog with a swivel clamp bar will be found invaluable, handling work you could not drive with an ordinary clamp dog.

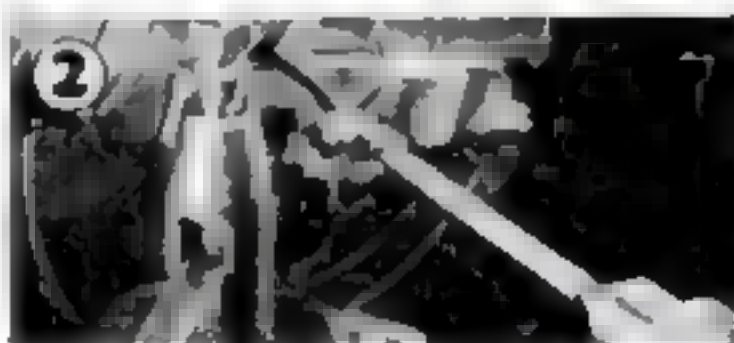
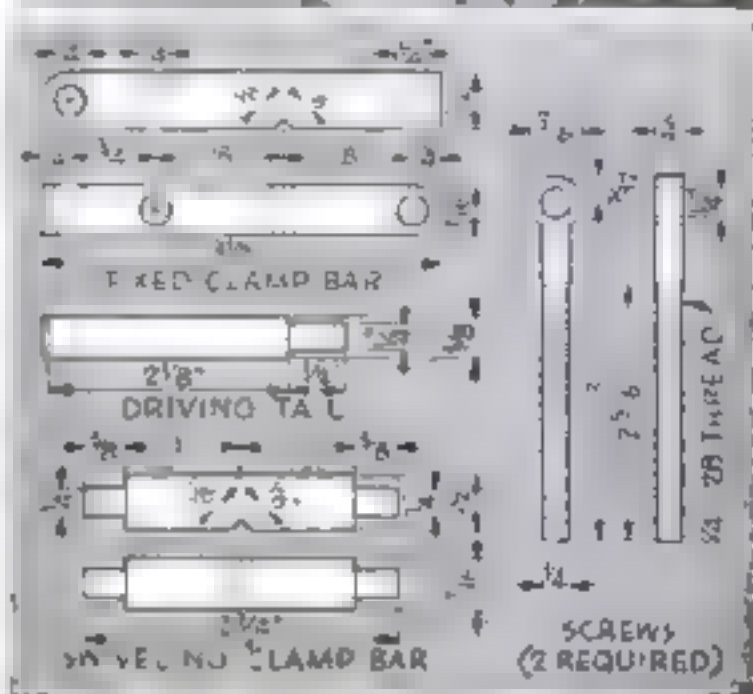
Set up $7/16$ " by $1/2$ " cold-rolled steel bar stock in the four-jaw chuck and turn the ends of the swiveling clamp bar, as shown in Fig. 1. The longer fixed clamp bar is made up mainly on the drill press, three $1/4$ " holes being drilled and the ends rounded as indicated. The V's for centering the work may be filed by hand. Make the driving tail from $3/8$ " rod shouldered down to $1/4$ " on one end and riveted tightly into the hole parallel to the notch on the fixed bar.

The two clamp screws are made up from $1/4$ " by $1/2$ " steel bar stock, chucked as in Fig. 2. First turn a screw to $1/4$ " diameter and next turn the head roughly to shape. Then, with the work still chucked, the threads are cut accurately, as in Fig. 3, the die being started by holding it squarely against the face of a drill pad and feeding it to the work with the tailstock handwheel. Drill the swivel hole in the end (Fig. 4) with the bar and screw held firmly in the drill-press vise, and finish a piece by cutting it off above the head and rounding the head to shape with a file.

Standard $1/4$ "-28 hexagonal nuts may be used for tightening the clamp bars. Two are shown in place on the screws in Fig. 5 with the other parts.

To assemble, slip the screw heads over the shouldered ends of the swiveling clamp bar and rivet each in place behind a small washer, taking care to allow enough play so the swiveling bar can be turned at any angle necessary. It must fit flat on tapered work to hold it securely during machining.

The dimensions given in the drawing are for a convenient small dog with adjusting screws permitting a good range of diameters to be accommodated. For work beyond 2" in diameter, a larger dog should be made up with the size of the parts increased in proportion.—C. W. W.



MORE USE FROM HACKSAW BLADES

By John Modroch

1 Your hacksaw is a carefully designed tool that deserves the best of care. Here are some tips from leading makers on the selection and use of the blades that, if you follow them, will produce better results and longer life for the tool. Take a natural, comfortable grip on the saw, holding it so the blade is slanting slightly forward and downward

2 Apply pressure with your wrists only; don't put your weight behind the saw. Lift it slightly on each return stroke; otherwise the teeth will, in time, lose their edge and become rounded. Be sure that the blade is inserted in the saw so the cutting is done on the down stroke

3 Cut with long, steady strokes, using all the teeth on the blade. Never go over 60 strokes per minute—40 to 50 per minute usually produce the best results

4 Excessive speed causes the blade to become clogged and rapidly wear out

5 The saw blade should be fine enough to allow at least two, and preferably three, teeth to come in contact at all times with the stock that is being cut

6 This blade is too coarse—replace it in accordance with the 3-tooth rule

7 Here the coarse blade that was used to cut through the I-beam flange is not right for the web. Stripping of the teeth results when they straddle work

8 Cut soft metals, such as brass, with a blade that has 14 teeth per inch. For hard stock, such as steel, a finer blade, with 18 teeth per inch, is right

9 For thin-wall tubing and lightweight pipe, use a 32-teeth-per-inch blade

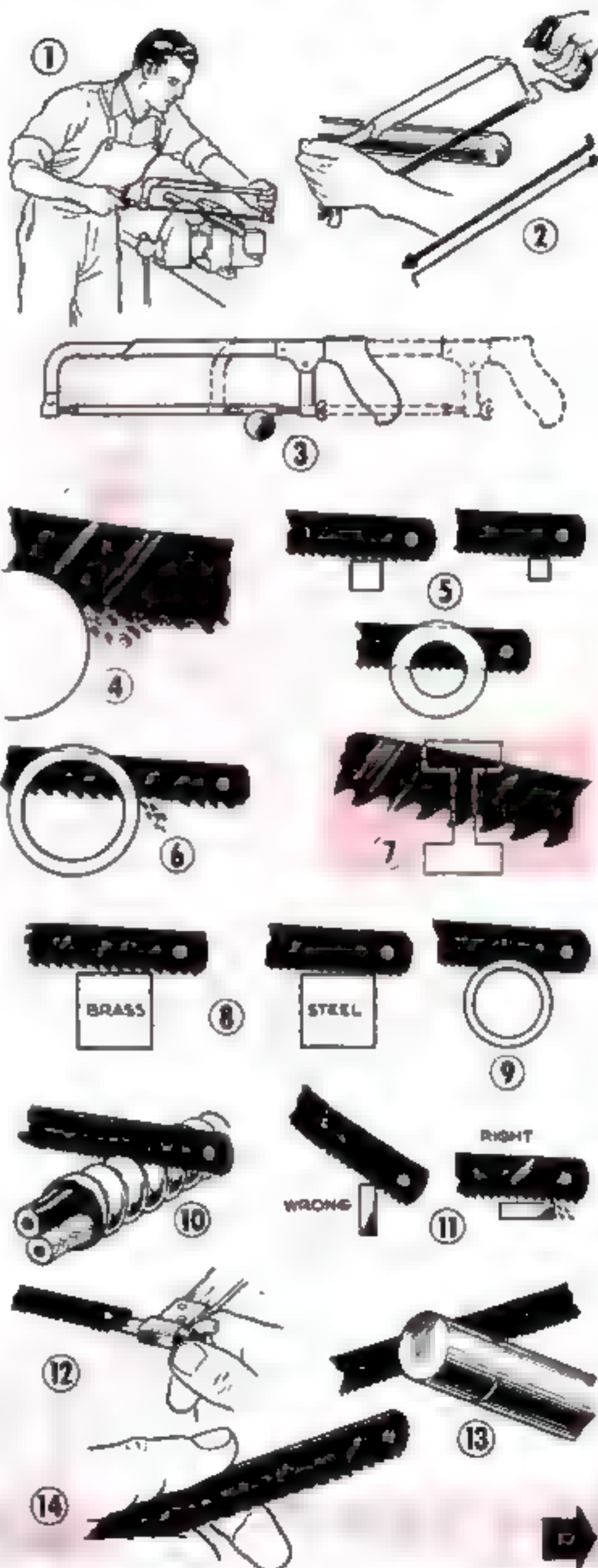
10 When cutting BX cable, it is best to use a flexible blade to prevent binding, which might cause the blade to break. Try one having 32 teeth per inch

11 Starting the cut at the wrong angle may cause the blade to break. Thin plate, sheet metal, and drill-rod stock should be cut with a 24-tooth saw blade

12 Too little tension allows the blade to bind; too much causes it to break

13 Don't use a new blade in an old cut; turn the stock over and start anew

14 Applying too much pressure or using the wrong blade may strip the teeth



15 Dull teeth may be the result of not applying enough pressure, inserting the blade with the teeth pointing in the wrong direction, not lifting the saw on the return stroke, or cutting too fast

16 If the teeth ride over the material without cutting and the points wear off, increase your pressure on the saw

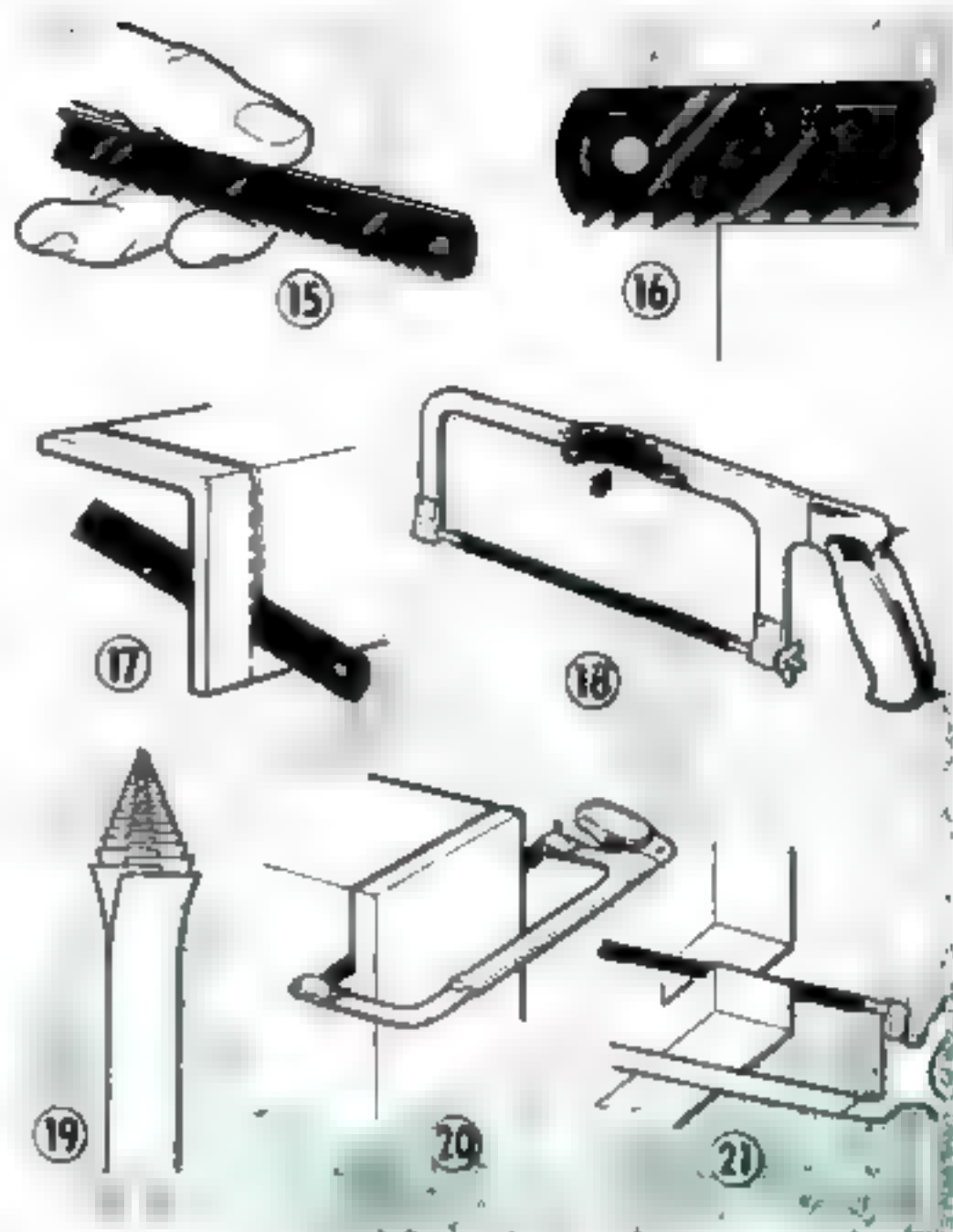
17 When the blade is held too loosely by the frame, it is hard to make a straight cut. This fault is remedied by tightening the proper adjustment device

18 A bent frame will twist the blade, causing it to make a crooked cut—guard against this by carefully hanging the saw in a safe place when not in use

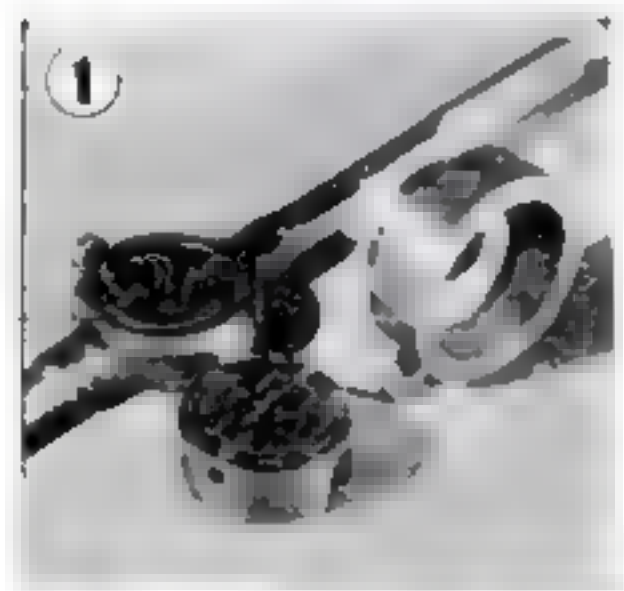
19 As the set wears off the teeth, the cut becomes too narrow to provide adequate clearance for the blade. This causes binding, which may throw the cut out of true. When this happens, replace the old, worn-out blade with a new one

20 Good hacksaw frames may be adjusted to take the blade so it will face in any one of four different directions. Here the blade has been inserted at a right angle so that a thin slice may be cut from a thick piece of stock

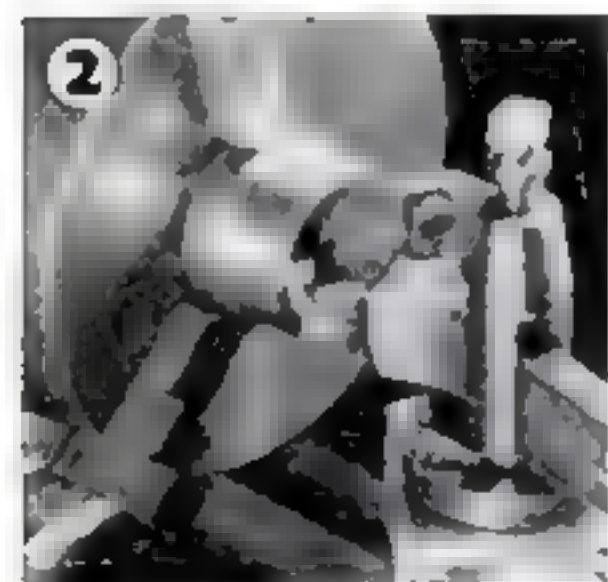
21 Reverse the blade in the frame to cut off small, hard-to-get-at stock



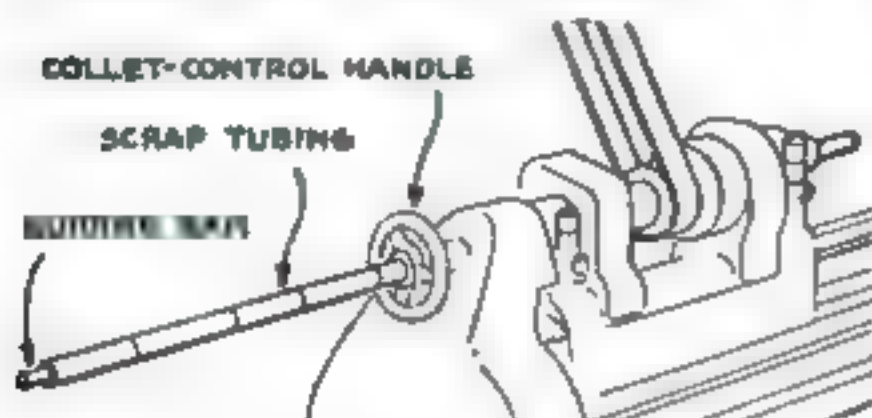
Oversize Die Held in Diestock by Specially Made Adapter



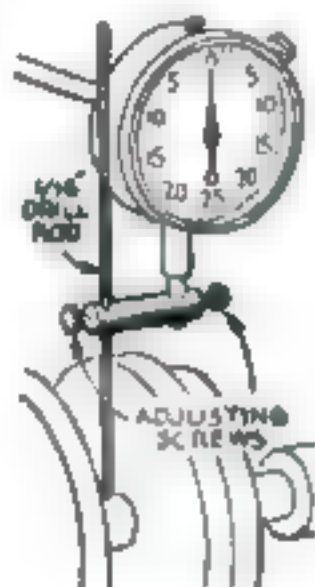
WHEN you must cut an odd-sized thread and the only available die for the job is too large to fit in a standard diestock, the adapter shown in Figs. 1 and 4 will hold it in place. Chuck a short piece of bar steel, as shown in Fig. 2, and bore it to take the die snugly, without binding and without shake. Reverse it in the chuck, as in Fig. 3, and turn the opposite end down to fit in the diestock. Drill and tap a hole in the side of the larger end to take the setscrew that holds the die in place. Countersink a dimple in the side of the smaller end to receive the nose of the diestock setscrew. To use, place the die in the adapter and the adapter in the diestock and tighten both of the setscrews securely.—C. W. W.



SHORT LENGTHS OF TUBING slipped over a guide bar can be fed into a lathe through the headstock as easily as long pieces. Push the foremost piece through the collet with more of the same tubing on the guide bar, and when the first piece is chucked, remove the bar and the remainder of the tubing until the next piece is to be inserted. Scrap bar stock can be pushed through a long pipe in the same way.—W. H. MCCLAY.



A DIAL GAUGE can be used to check recesses, inside holes, behind blockings on faceplates, and in other inaccessible places simply by the addition of a 1/16" drill-rod extension to lengthen the relatively short spindle of a standard gauge, as shown in the drawing at right.

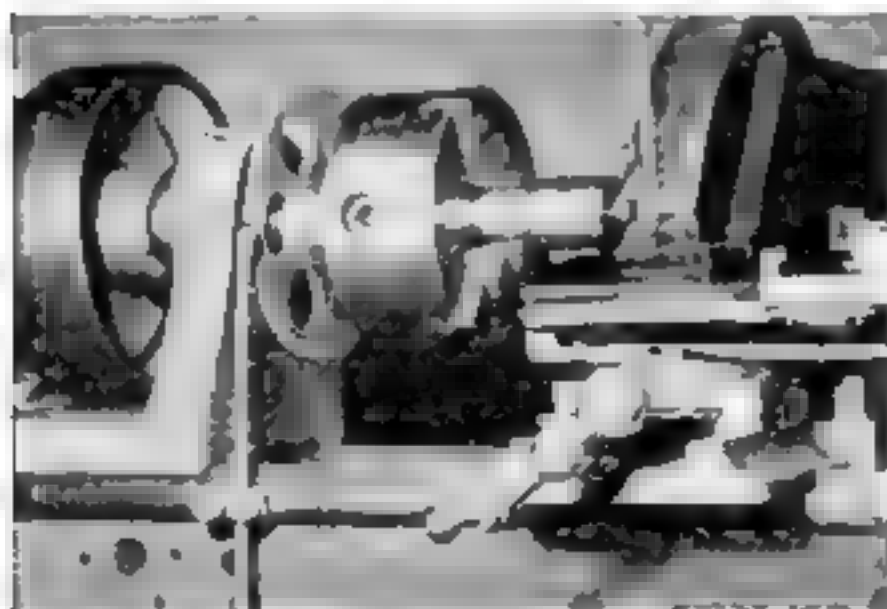
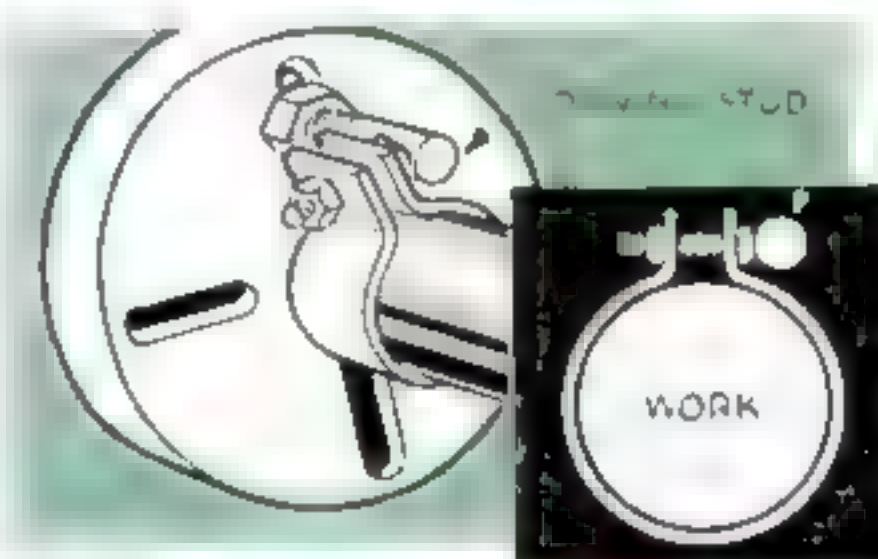


The drill rod is adjustable as to length, sliding in a sleeve by means of which it is held to the indicator-gauge spindle. Thumbscrews at either end of the sleeve permit the necessary adjustment to reach the surface to be tested. A set of rods of various lengths can be provided. Some may be straight and others bent to shape to suit the particular jobs you have in hand.—A. E. CHARTERS.



HARD-TO-CHUCK WORK is handled efficiently in the lathe by clamping it in a small drill vise first, and then mounting both the drill vise and work in the four-jaw chuck, as shown above. Small-diameter rods can be held parallel to the face of the chuck, or long, thin, oddly shaped parts that cannot be chucked alone may be mounted firmly. Tape the vise-screw handle to the chuck body to keep it out of the way.—C. W. W.

LATHE DOGS for work of large diameter may be fashioned from heavy strap iron, as shown below. Shape the piece in a vise around stock slightly smaller in diameter than the work, bend up the ends, and drill them for a clamping bolt.—J. S. MORREL.



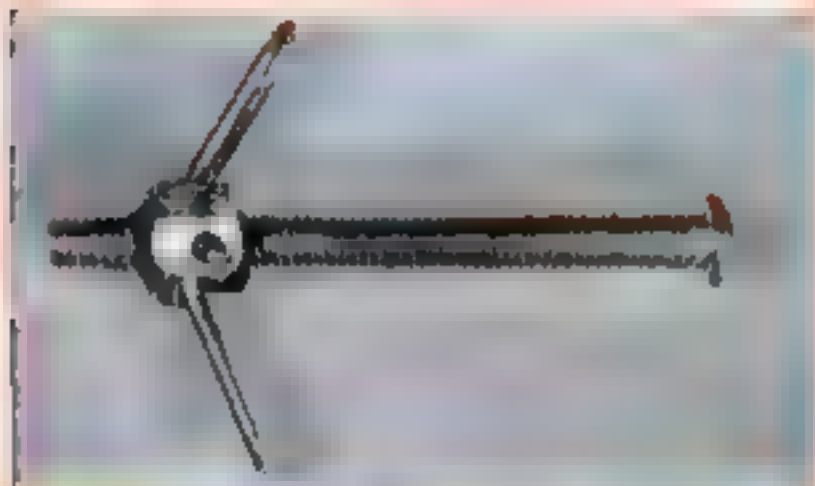
ACCURATE INDEXING is possible in the lathe with the aid of a flat steel spur gear about 3/16" thick having 180, 360, or some other number of teeth readily divisible into equal parts. Bore the gear to fit the spindle nose and clamp it behind the chuck, or bolt it with the work to the faceplate.

Make an index bar from 1/4" diameter drill rod, bending the tip at 90 deg. and filing it to fit between two gear teeth; then clamp the bar to the lathe so it will exert enough pressure to eliminate backlash. Mark off positions on the gear, using dividers to count teeth.—J. C. MAGEE.

Question Bee

IF YOU went into your hardware store for a bolt for a special job, would you be able to name the bolt right away, or would you have to describe it or tell the dealer how you wanted to use it? Below are shown 10 screws and bolts that

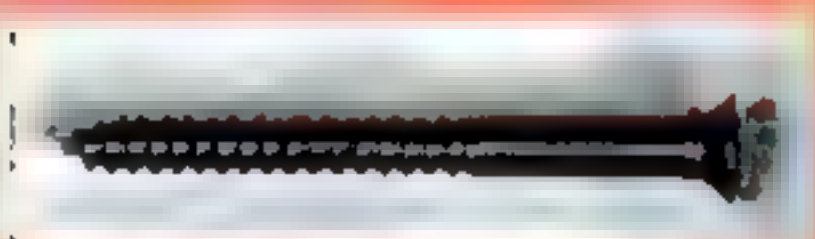
should be familiar to the average home mechanic. How many can you name? Write your answers in the space provided beneath each photo; then turn the page upside down to compare your list with the correct answers given below.



1



2



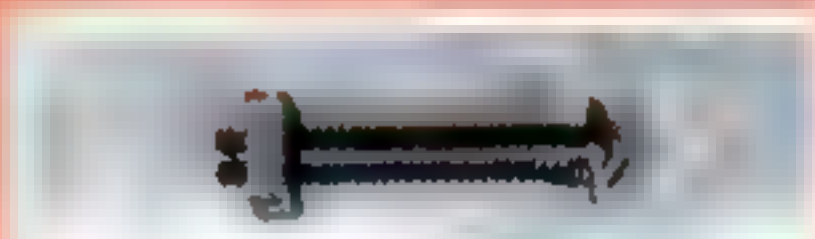
3



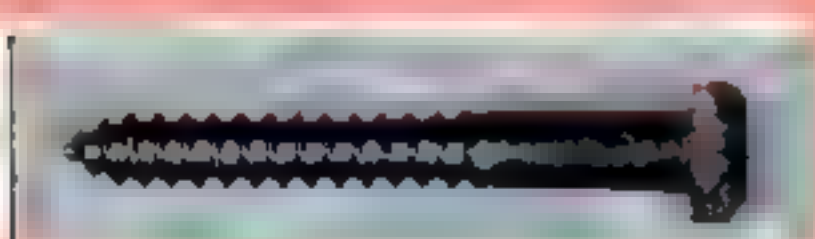
4



5



6



7



8



9

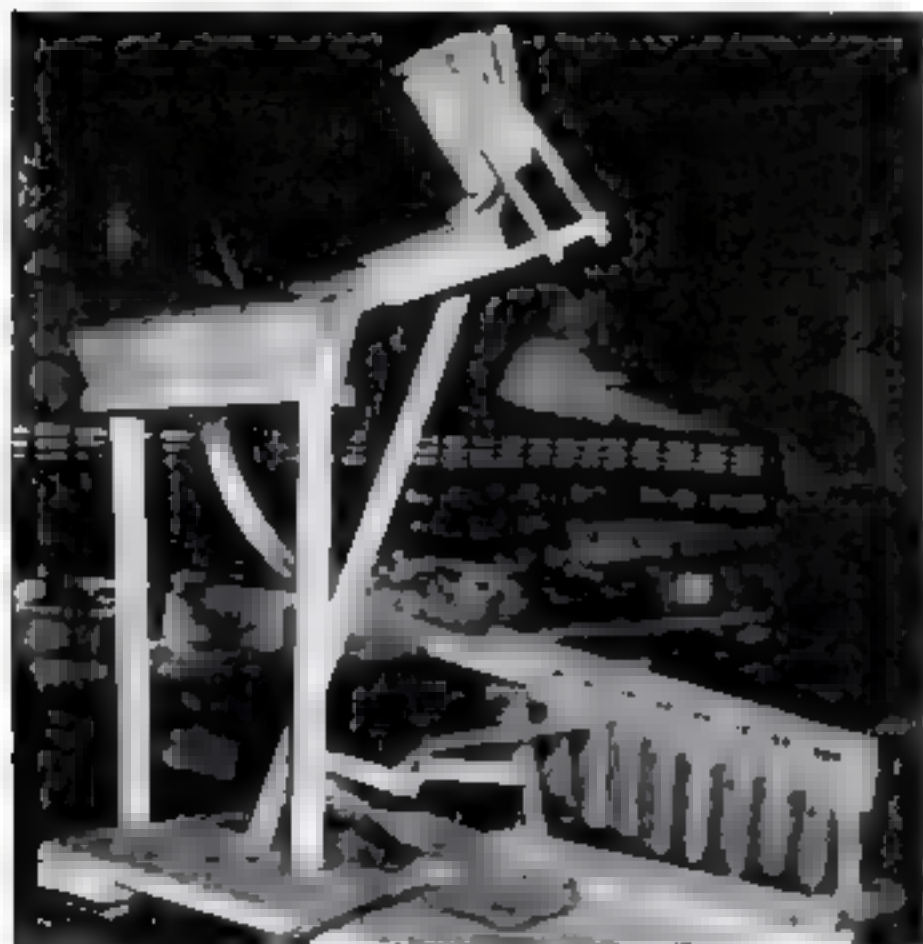


10

ANSWERS

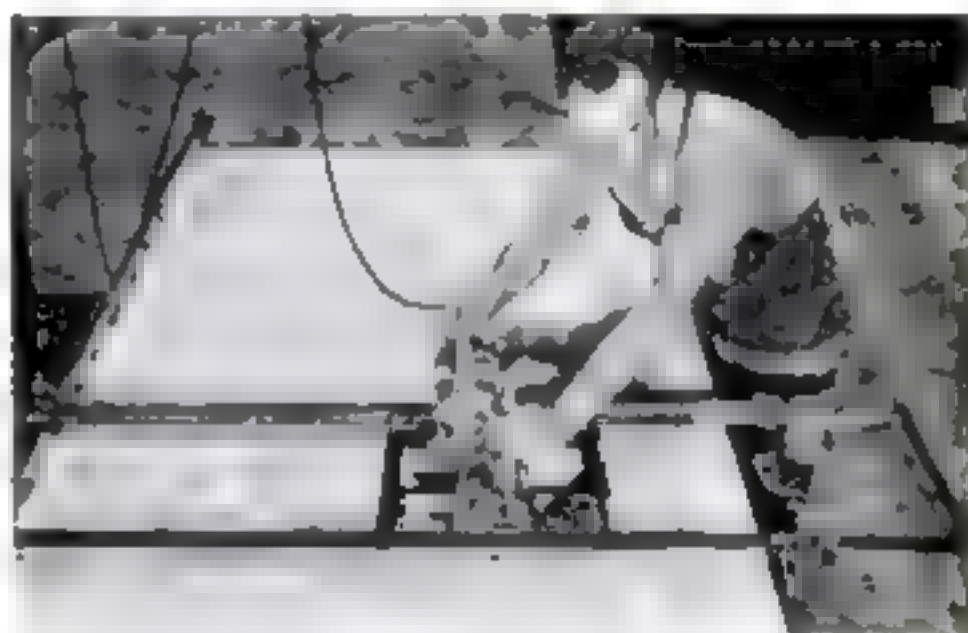
1. Toggle bolt.
2. Flathead wood screw.
3. Round-head stove bolt.
4. Square-head coach bolt.
5. Square-head machine bolt.
6. Round-head stove bolt.
7. Lag screw and expansion shield.
8. Flathead stove bolt.
9. Oval head carriage bolt.
10. Lag screw and expansion shield.

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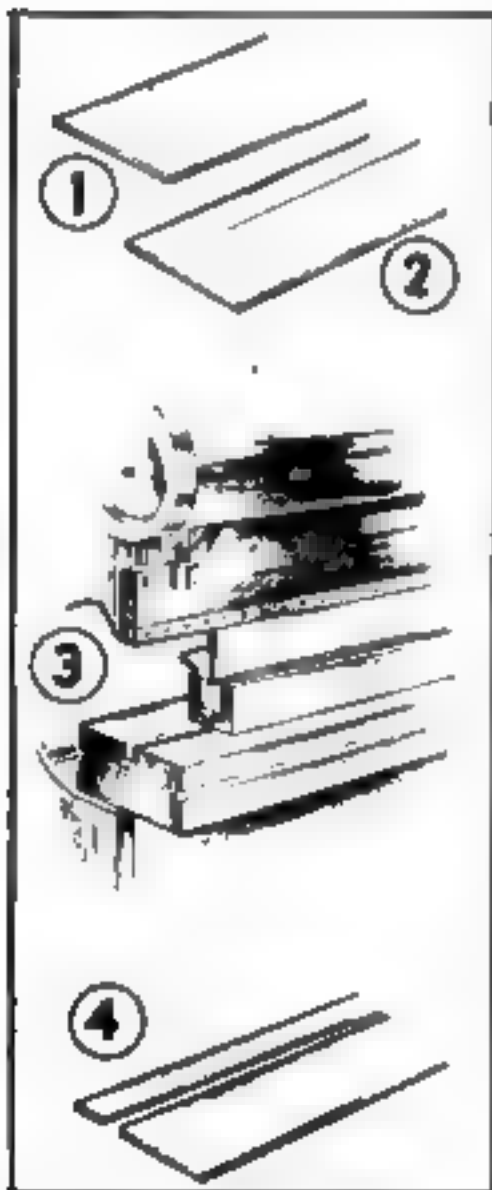
PLYWOOD OR COMPOSITION BOARD of standard sizes may be sawed lengthwise or across in this jig. A portable power saw is mounted on a square angle-iron frame that is cradled in another frame. This second frame is rectangular, being just wide enough to take the first one and somewhat longer than the width of the sheet to be cut. It has wheels that run on two parallel rails along the length of the sheet. C. Derho, a worker at Northrop Aircraft, Inc., Hawthorne, Calif., who developed the jig, is shown, below, ripping with it. When he wants to crosscut, he locks the wheels, thereby securing the larger frame, and turns the smaller frame and saw a quarter revolution to the right. The long sides of the larger frame then become the tracks.

RIVET SORTERS, now fairly common, are interesting if they are, like this one, particularly ingenious. The rivets are put in the top hopper. Falling through it, they land head up in a curved runway where they are inverted by traveling around the inside of the curve. Then they slide down a slotted extruded-metal slope. When a rivet reaches a slot into which it can fit, it falls through into a removable receptacle. The sorter is vibrated by a compressed-air oscillator to keep the rivets in motion.



MAGNESIUM SHEET is now cut, by a new method, in one third the time formerly taken. The blank sheet, Fig. 1 at the left, is scribed, Fig. 2, and placed in a power brake, Fig. 3, with the scribed line down. When pressure is applied directly above the line, the sheet breaks clean and true, as in Fig. 4. The method was devised by Stanley Carroll, of Northrop Aircraft, Inc.

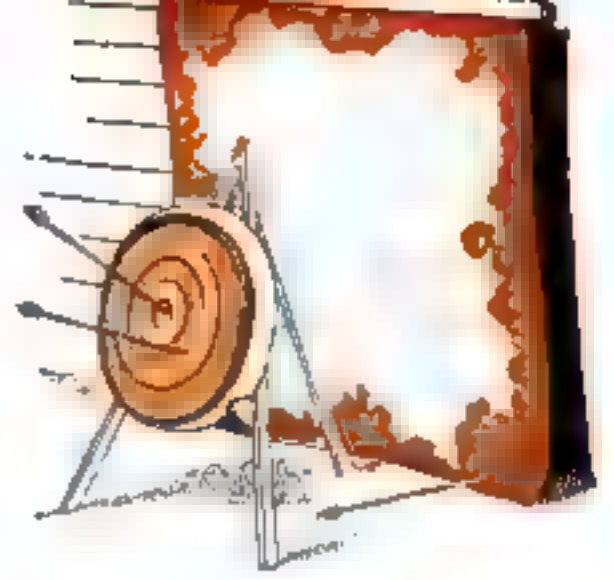
SCALE MODELS of the new Victory ship are used by instructors at the California Shipbuilding Corporation, of Los Angeles, to familiarize workers with the vessels and rigging.





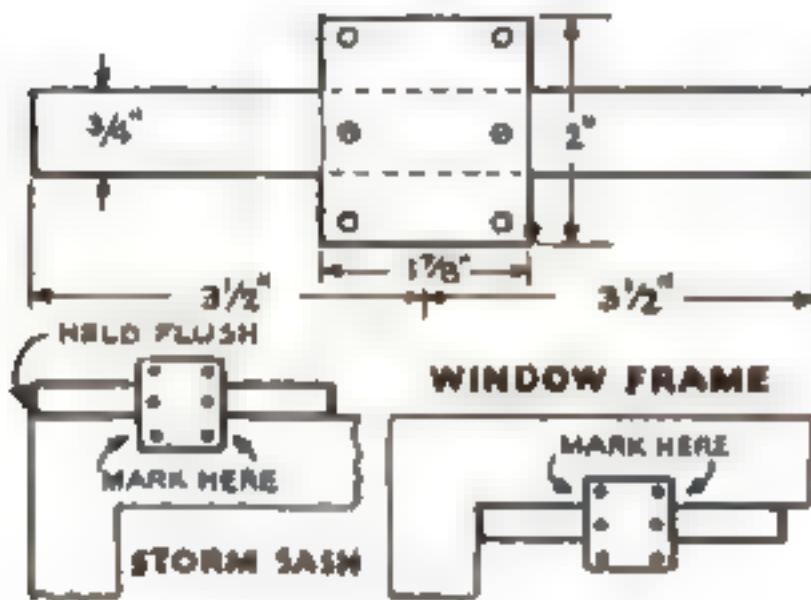
IF YOU have a large, fairly heavy rug that is ready for discarding, or if you can get one, you can set up an archery range in your back yard or driveway. Hung 12" from a wall on brackets, as indicated at the right, the rug will break the force of arrows that miss the target and keep them from being damaged against the wall.

The rug may be hung inside a garage at the back, if desired, and the arrows shot through the open door to add length to a driveway range. If you can get two rugs, hang one about 12" in front of the other for additional protection.—RUTH M. LUTHER.



Tack the rug to 1" by 3" stock, insert screw eyes near the ends, and hang it about 12" off the wall.

Simplified Template Helps in Fitting Storm Sash Quickly



FOR starting screw holes in window frames and the storm sash and screens to be fitted, I find a small template made of scrap plywood or other stock ideal. In use, the marking guide is placed against the outside edge of the sash, as shown at the left, and on the inside of the window frame to locate screw holes for the mating hook. Use it on one side and then the other. Bore $\frac{3}{8}$ " diameter holes in the template, locating them in the exact position of the holes in the hangers. Using the gadget, I dressed and fitted 19 screens and 19 storm sashes on my home this year with a minimum use of the ladder.—FRANK J. SCHMITT.

Inside Kennel with Exit to Outside Keeps Dog Comfortable

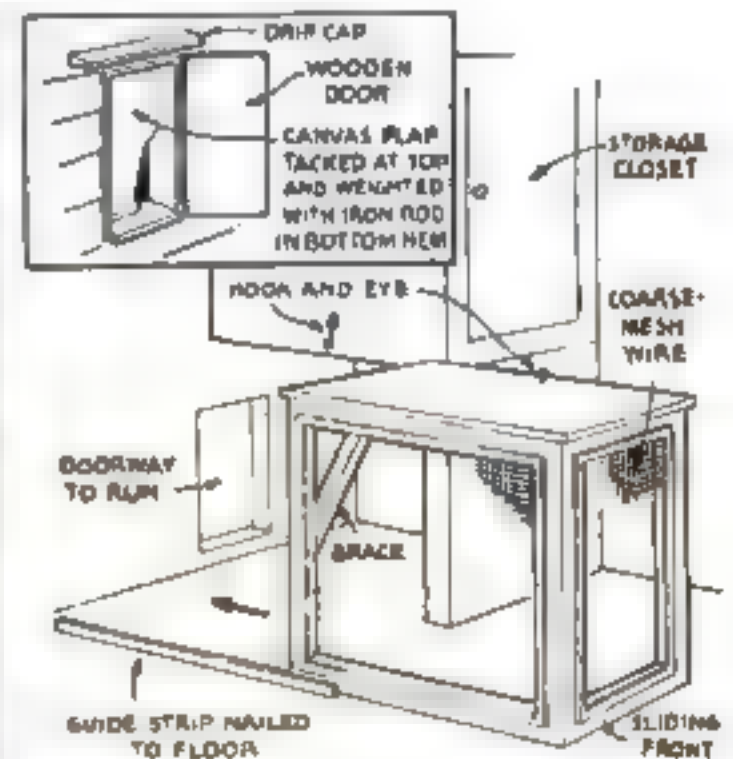
WHEN it is desirable to limit the range of a dog, this housing setup assures the dog's comfort in all kinds of weather. It is easy to clean and may be installed in a studio, workshop, or garage, and also may open on a fenced-in exercising run.

Space under a storage closet can be utilized, as shown. If the heat source in the room is at one side, add the screened front so the dog can get direct heat in cold weather. Such an extension front will add to the dog's contentment by permitting vision of the activities in the room.

A weighted canvas flap, under which the dog can nose its way in or out, closes the outside doorway against the weather. The hinged

wooden door may be shut at night and on extremely cold days.

For the setter in the photo, the doorway was made 12" by 20", the space under the closet 30" by 30", and the extension 15" by 30". The height was 27".—J. M.





Pointers on Using a Corn Picker

By E. W. LEHMANN

*Head of Department of Agricultural
Engineering University of Illinois*

ONE man with a two-row tractor-driven corn picker can harvest in a few days and with comparative ease a crop that might require weeks of arduous hand labor. With no other help, he operates and controls the tractor, the picker, and a wagon in which the husked corn is collected. If necessary, the picker can be worked night and day to harvest the crop while good weather lasts and early enough in the fall to minimize loss.

In spite of this, however, U. S. Department of Agriculture reports show that more labor is expended on harvesting the corn crop than all other crops. This is because, even with a labor shortage and the ranking of corn as America's most important crop, much is still harvested by hand, a condition that causes some farmers with power-operated planters and cultivators to grow more corn than they can pick.

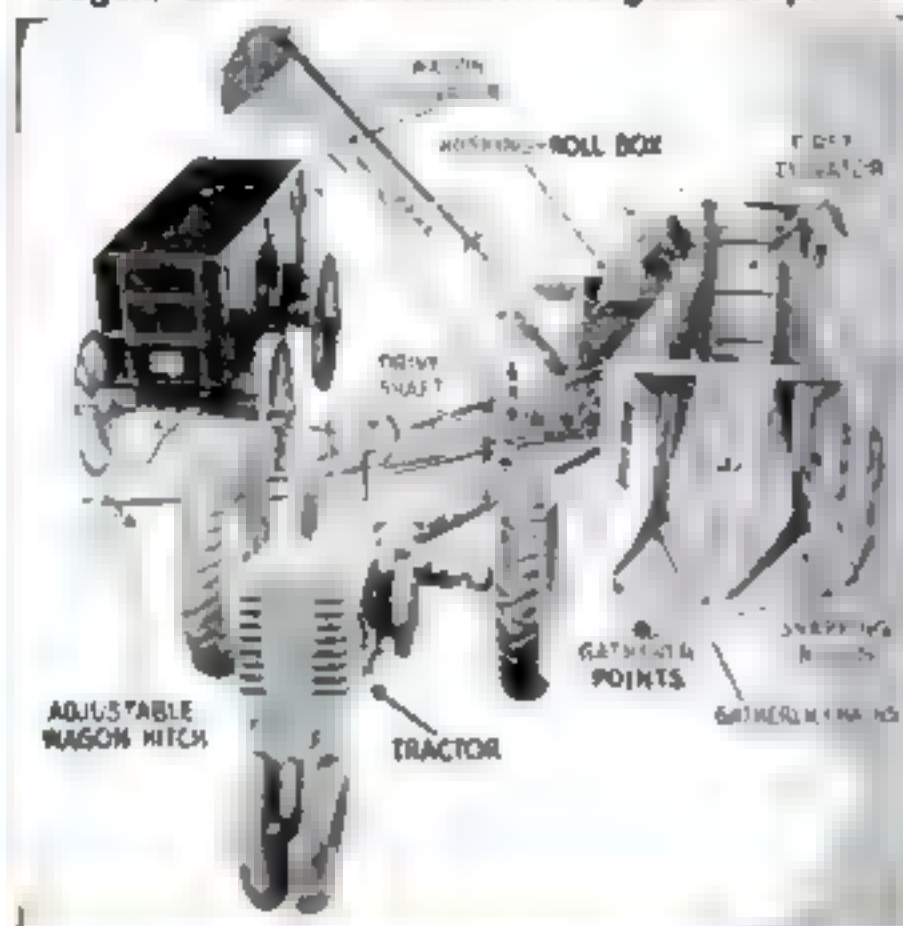
It is doubly necessary this year when corn is so badly needed to keep at the peak of efficiency those corn pickers that are in operation. This is simple enough if a farmer gives a little time to maintenance.

Corn pickers are of two general types—one mounted or "pushed" and the other tractor or team-drawn—and both kinds include single and double-row pickers. Some pickers are equipped with an overhead tank into which the corn is discharged, while others pull a wagon behind or alongside.

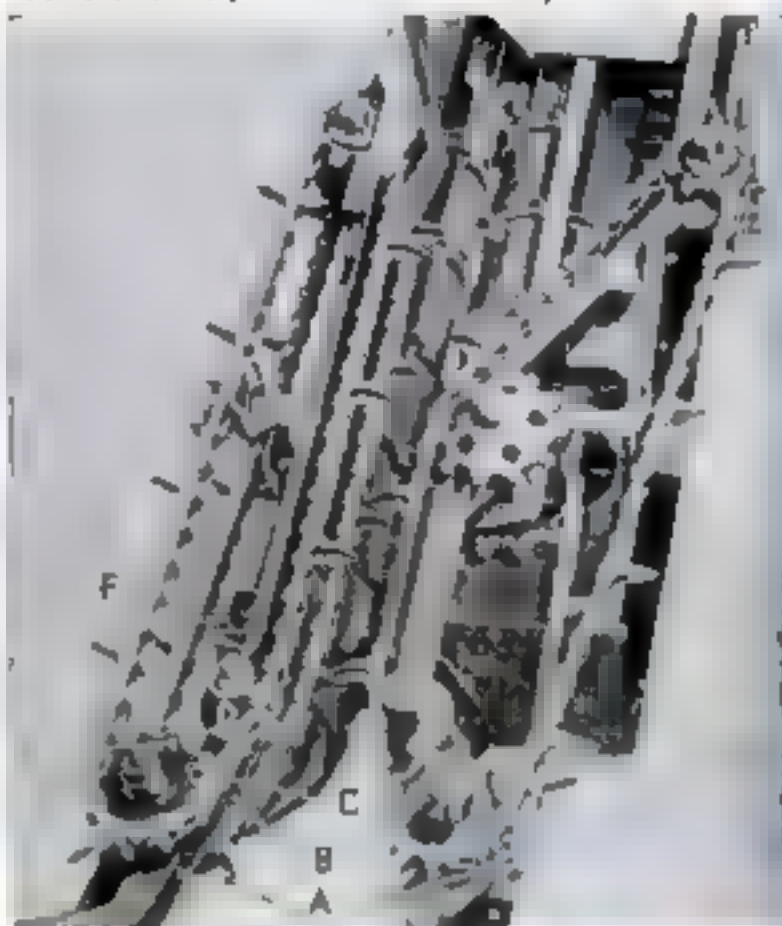
What a picker does is pick the corn, husk it without shelling, that is, without removing kernels from the cob, separate it from chaff, and deliver it to the wagon or tank. It gathers the stalks into snapping rolls by means of gatherer points and chains, snaps the ears from the stalks in the snapping rolls, husks the ears in husking rolls, discards husks and silks with the aid of a fan and screen, and delivers the ears through an elevator. Some late models are equipped with a slatted conveyor under the husking rolls to separate shelled kernels from trash. An air blast blows trash out, and the shelled corn drops through the grate to be elevated into the wagon or tank with the ears.

In operating a picker, keep the machine tilted so the gatherer points will be close to the ground and the gatherer chains will pick up stalks that are lying down or leaning and guide them into the snapping rolls. Run the gatherer chains with the flat side of the lugs next to the corn, see that lugs on the

This tractor-drawn, double-row picker delivers clean ears through the elevator to the attached wagon. Corn enters between the gatherer points



Gatherer chains are at A and B, adjustable sprockets at C, snapping rolls at E, idling rollers at D, and the roll adjustment at F



outer chain are midway between those on the inner chain, and adjust the tightener to maintain proper tension. To conform with ground conditions, raise or lower the gatherer points by moving the hinge plate into the desired set of adjustment holes.

For small corn and for heavy, damp corn, set the snapping rolls as close together as possible without allowing them to touch. This prevents shelling, which can be caused by the rolls being too far apart. When corn is dry, the snapping rolls should be somewhat further apart.

The snapping rolls should carry the stalks through without uprooting them and must not be allowed to get out of time when they are replaced after having been removed. Keep the bearings well oiled, especially those close to the ground, for the latter are subject to considerable wear. Insert steel pegs on snapping rolls that have worn too smooth to pull stalks and trash through.

Husking rolls also work in pairs, and one of each pair is provided with husking pegs that loosen the husks. Worn or broken pegs should be replaced, but if the husking rolls shell too much corn, some of the pegs may have to be removed.

Timing of husking rolls is correct when the flat surface of one roll meets that of the other exactly and when the husking pegs fit into their small pockets on the mating roll. Tension springs permit objects to pass through the rolls without breaking them,

and they should be tightened if the corn goes unhusked, but avoid excess tension.

Agitators distribute the ears evenly and line them with the husking rolls. Raise the agitators when picking corn with large ears and lower them for small ears. Insure clean husking by keeping enough compression on the ear retarders, but remember that too much compression may cause shelling.

The husks are carried out by a husk conveyor, and the clean ears pass from the husking rolls to an elevator hopper that is large enough to hold the surplus corn delivered to it when the elevator is stopped for changing wagons or turning. A safety clutch is provided for the elevator drive to prevent the breaking of chains and other parts if the elevator becomes clogged. When such clogging does occur and the clutch is thrown out by the added load, the operator should stop the picker at once and locate the trouble.

For best results in picking corn, operate the machine at a uniform speed, center on rows as nearly as possible, and drive carefully. A speed of more than 600 r.p.m. may be one cause of shelling. Preventive maintenance should be practiced by checking the entire machine frequently for loose bolts, setscrews, and cotter pins, and by carefully lubricating all bearings and moving parts in accordance with the maker's instructions.

To avoid accidents, never make adjustments or lubricate any part while the picker is in motion. Picker rolls have maimed many

These are husking rolls in a one-row picker. Note the adjustable compression springs in the foreground just above the husk conveyor



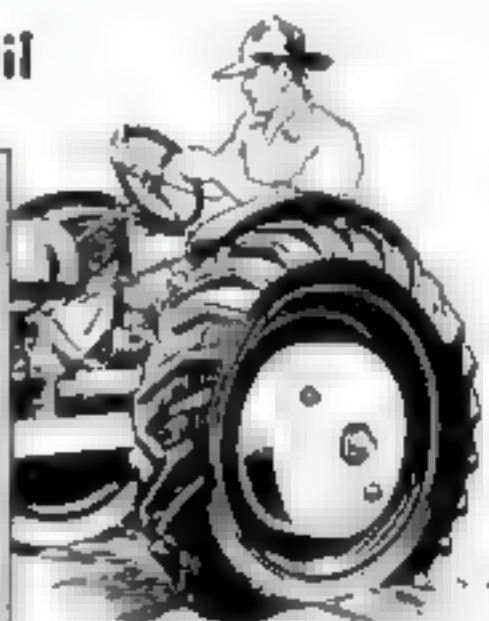
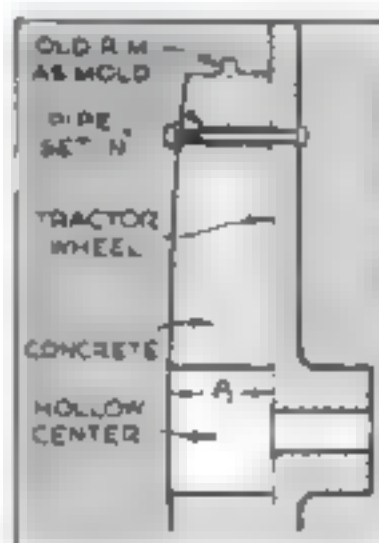
a luckless farmer who failed to heed this. If shields or guards are removed in servicing, put them back before starting the machine. Check safety clutches occasionally to be sure they function. A slip clutch that is too tight gives no protection. Mounted pickers have been known to catch fire from trash accumulating on or near the exhaust manifold. A metal sediment bulb on the tractor carburetor is a good safety precaution.

As soon as harvesting is completed, the picker should be put in a shed and thoroughly cleaned of dirt, caked grease, parts of stalks, husks, and silks. Then grease all bearings thoroughly to prevent accumulation of moisture during the winter and spring. Remove all roller chains, wash them in kerosene, dip them in clean oil, and wrap them in heavy paper or burlap to keep out dirt. Oil the remaining chains and the sprockets and rolls with heavy oil. Be careful not to get oil on rubber rolls because it may cause deterioration. If the picker has rubber tires, block it up and deflate them.

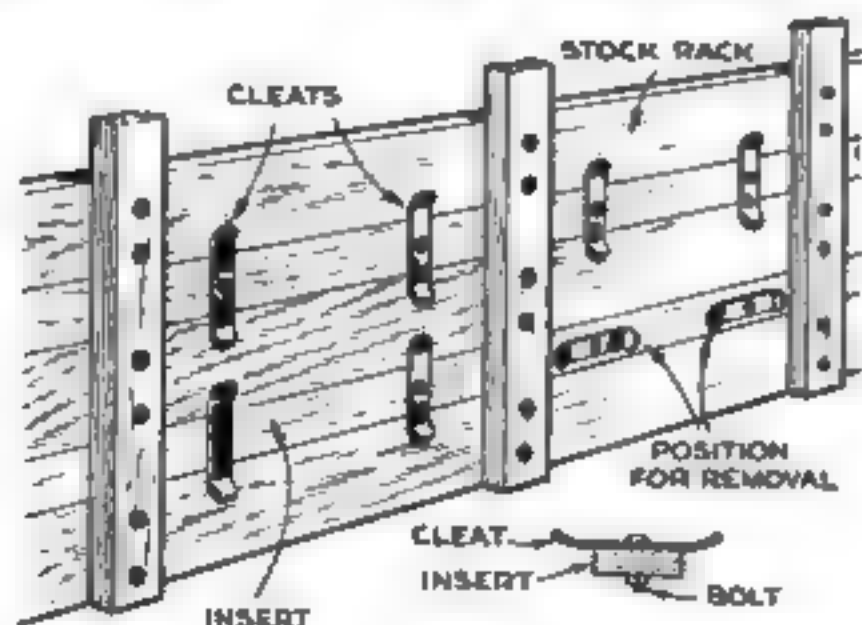
Finally, check the entire machine for badly worn and broken parts in time to replace them before the next harvest.

Ballast for Farm Machinery on Hard Soil

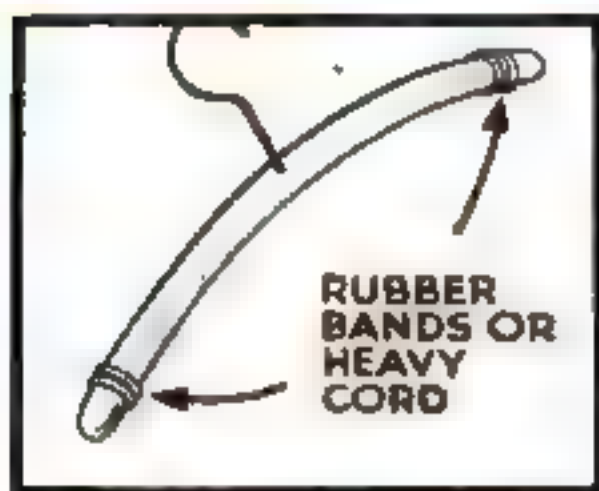
TRACTORS, disk harrows, and other cultivating machines are often too light to work hard soil satisfactorily. If you can't obtain the metal weights often used to correct this, try adding ballast in the form of thick concrete disks that are bolted to the wheels or secured to the machines with chains. They may be formed by using a discarded wheel rim and a bucket for the molds. Short lengths of pipe, cast into the ballast weight, provide holding-bolt holes.—BRUCE MACINTOSH.



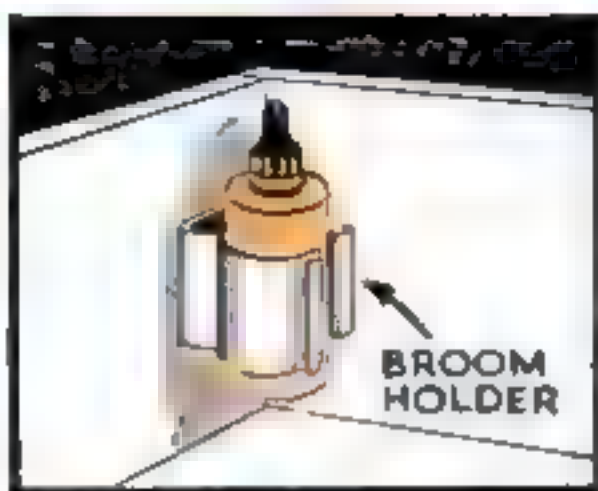
Simple Inserts Allow Grain to be Hauled In a Stock Rack



YOU can quickly convert the body of a stock-carrying truck or trailer into a grain-tight box by making inserts of wood that are the same thickness as the sides of the body and as wide and long as the space between the sideboards. Install two cleats on each insert between each body upright. These may be made of $\frac{1}{4}$ " by 1" strap iron, bent as shown, or of wood. When they are vertical, they hold the inserts in place. When they are horizontal, the inserts may be quickly and easily removed.—RALPH STEIDER.



Rubber bands or a couple of turns of cord will provide hangers with anchors to keep dresses and slips from sliding off them at the ends

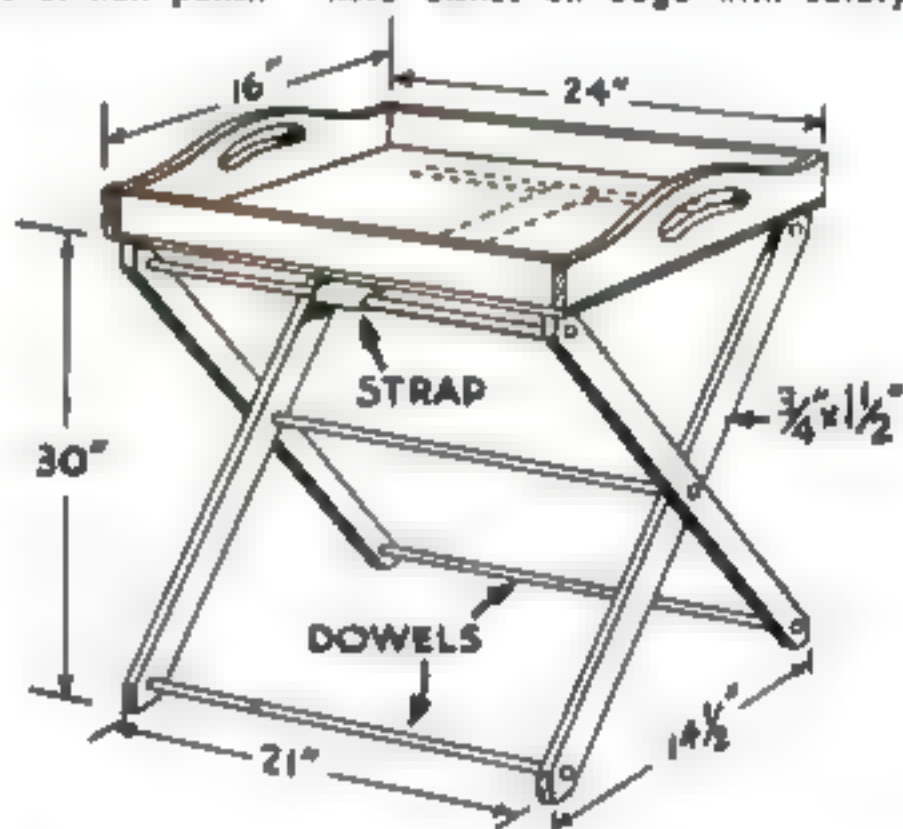
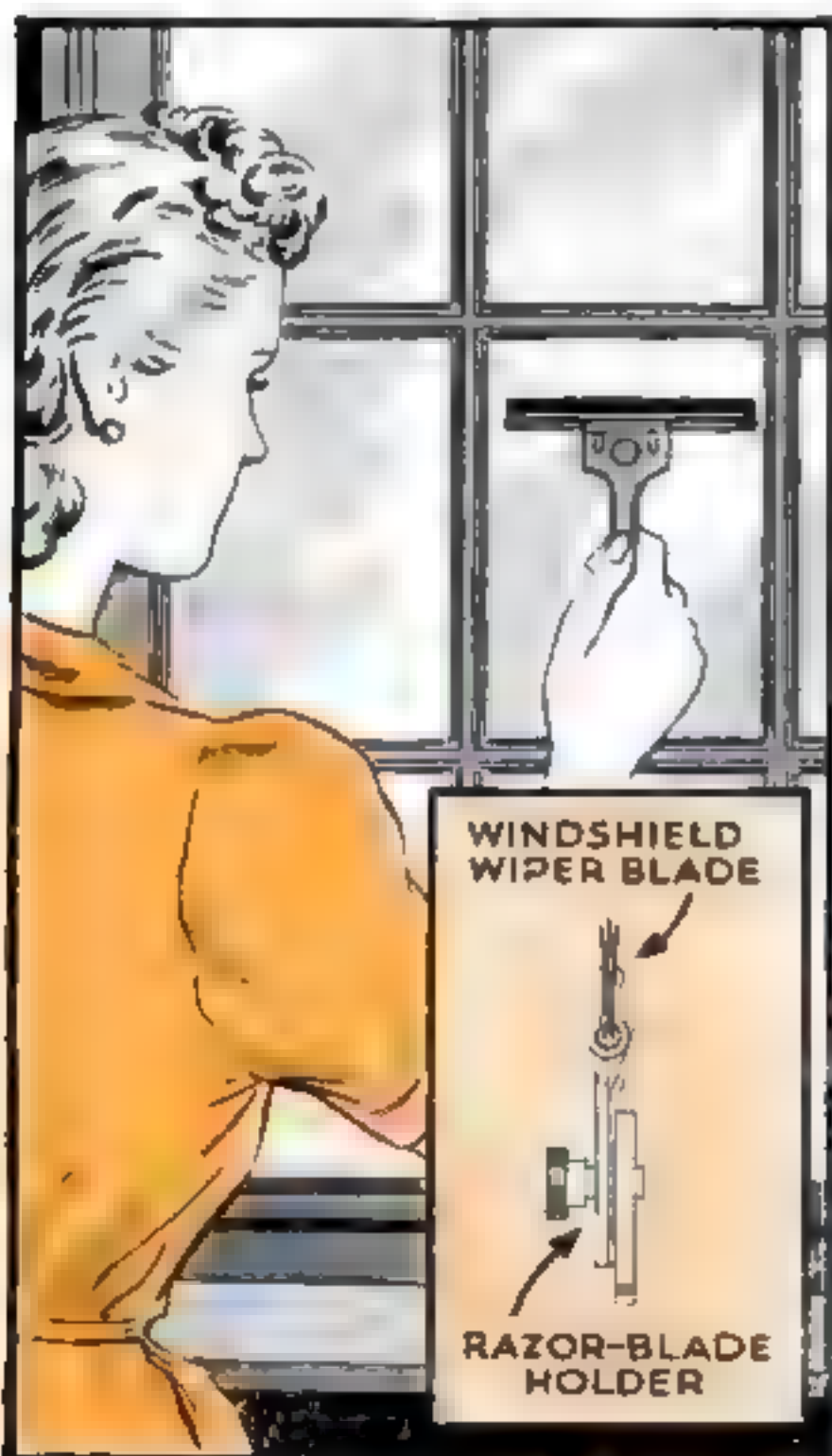


Attached near an inside corner of a vanity drawer, a common broom holder prevents tipping over and spilling of a bottle of nail polish



Corrugated cardboard cut into strips and glued near the back of a cupboard or plate rail will hold dishes on edge with safety

Small window panes are cleaned efficiently with a squeegee made from a windshield-wiper blade cut to suit. A glass scraper designed for use with old razor blades forms a convenient handle. The wiper blade should fit the smallest pane to be washed



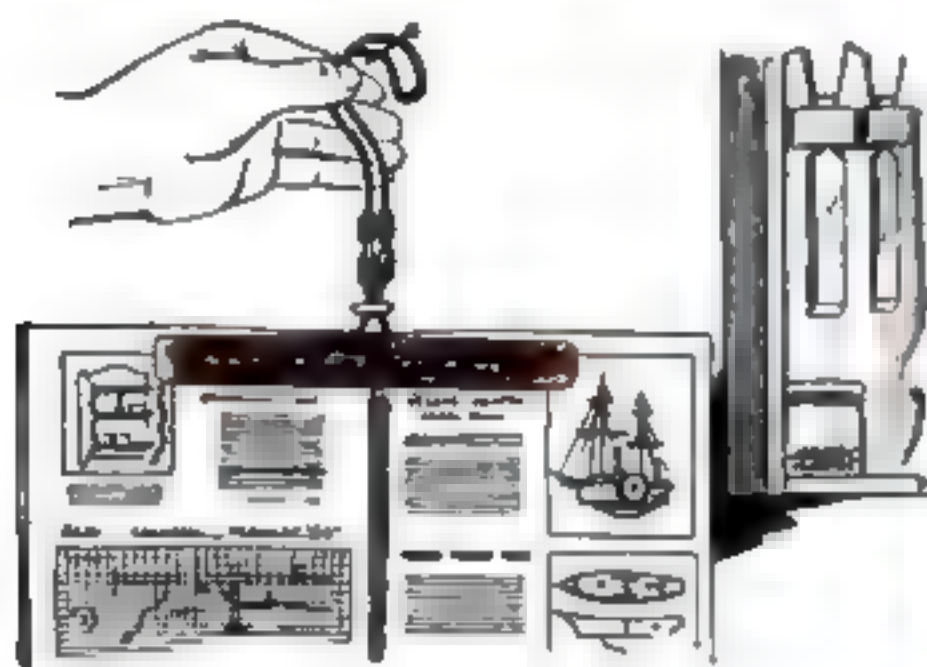
For a folding serving stand useful either indoors or out, join four 34" legs with glued dowels, as shown, making three of the dowels long enough to extend through the outside legs and the center hole in the inside legs large enough to prevent friction. The strap is canvas or webbing. Any 16" by 24" tray may be used, or make one as shown

Several ice cubes in a shallow dish will make an excellent moistener for the glue on the flaps of envelopes, especially when many have to be sealed



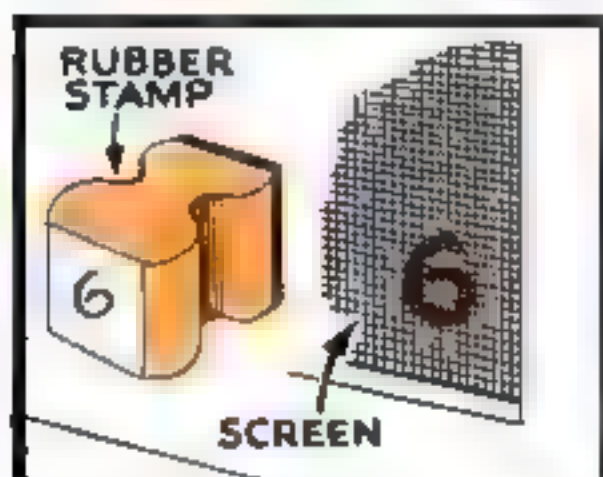


Painting the bottom siding board the same color as the floor of a porch will often help preserve neatness. Marks from scuffed shoes and streaks from washing the porch won't show up so quickly.



Plans for your current project from the pages of **POPULAR SCIENCE** or a set of blueprints can be clipped in a trousers hanger and held on a nail at eye level, thus keeping the workbench clear. Clip the entire magazine, opened at the desired pages.

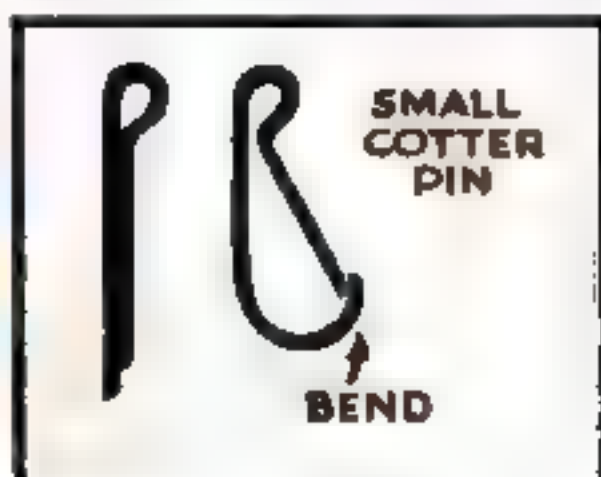
Numbers identifying screens and storm sashes can be put on with rubber stamps dipped in house paint. They won't show on the outside of the screens and, if small, aren't noticeable inside. After using, clean the stamps.



Ordinary rubber-headed tacks or upholsterer's nails having large round heads prevent the bunching of clothes on a clothes pole in your closet if driven into the pole at intervals. This keeps clothes neat and easy to take out.

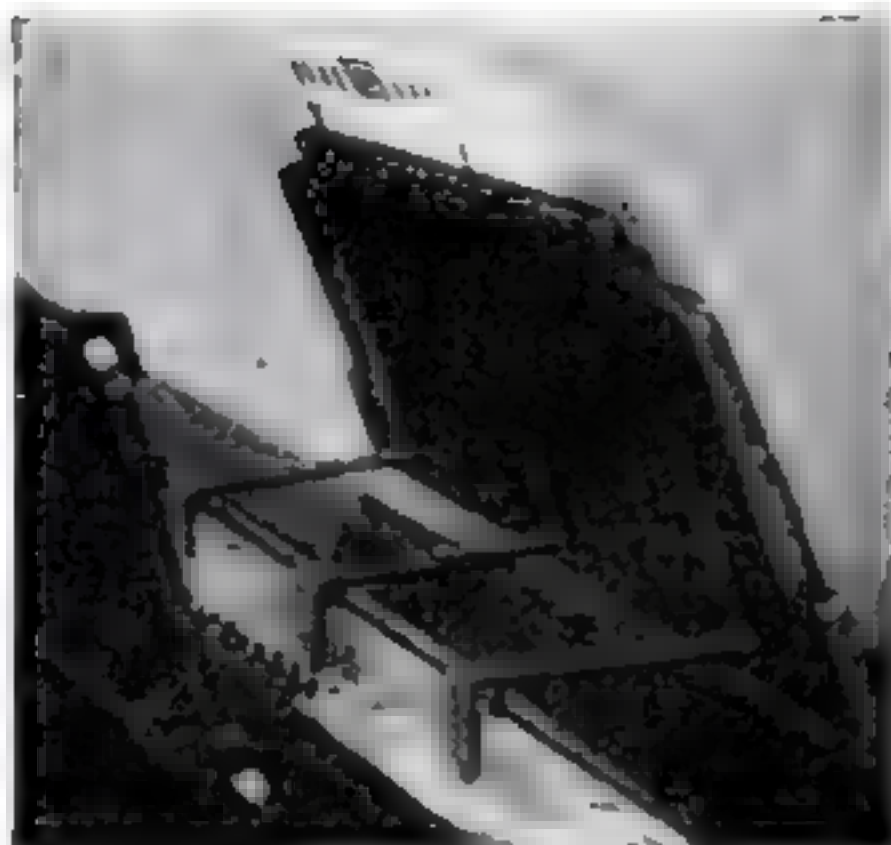
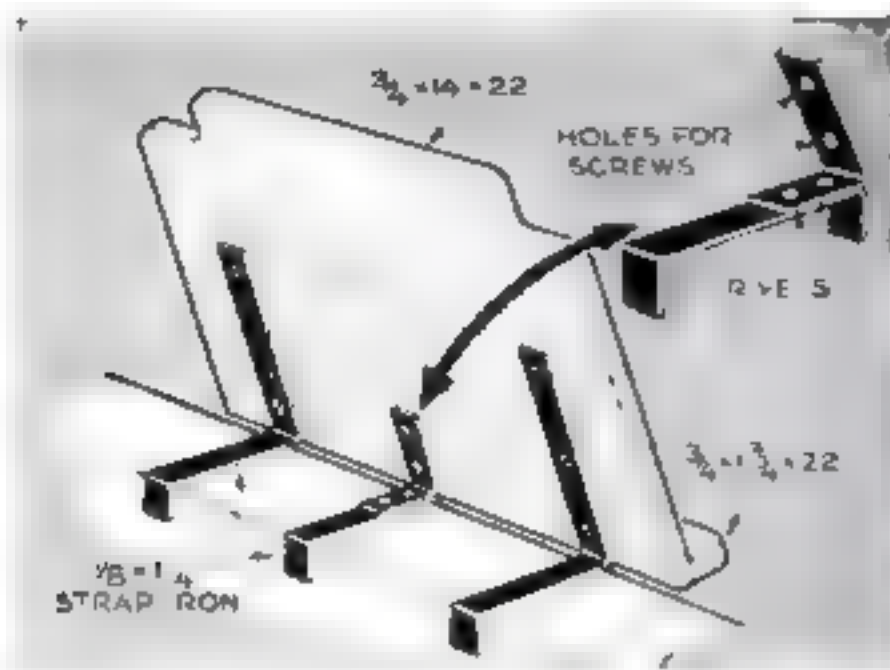


Cotter pins of various sizes can be bent to the shape shown below for use in replacing broken key clips in a leather key container, or as key rings or belt clips to hold key rings. Large pins will also hold small tools on a belt.



Bent over the edges of a gutter and sloped down on the inside at one end, as shown above, $\frac{1}{4}$ " mesh wire screening serves as an effective drainpipe strainer. Water forces leaves up and over. Shop lamp guards also can be used. Most are rustproof.

Extension Rack for Sheet Music Is Attached to Grand Piano



MADE this removable music rack to fit on my grand piano. It holds music closer to the player's eyes than does the regular rack, and is ideal for children and near-sighted persons. A clamp, riveted to an angle brace, and two brackets support it

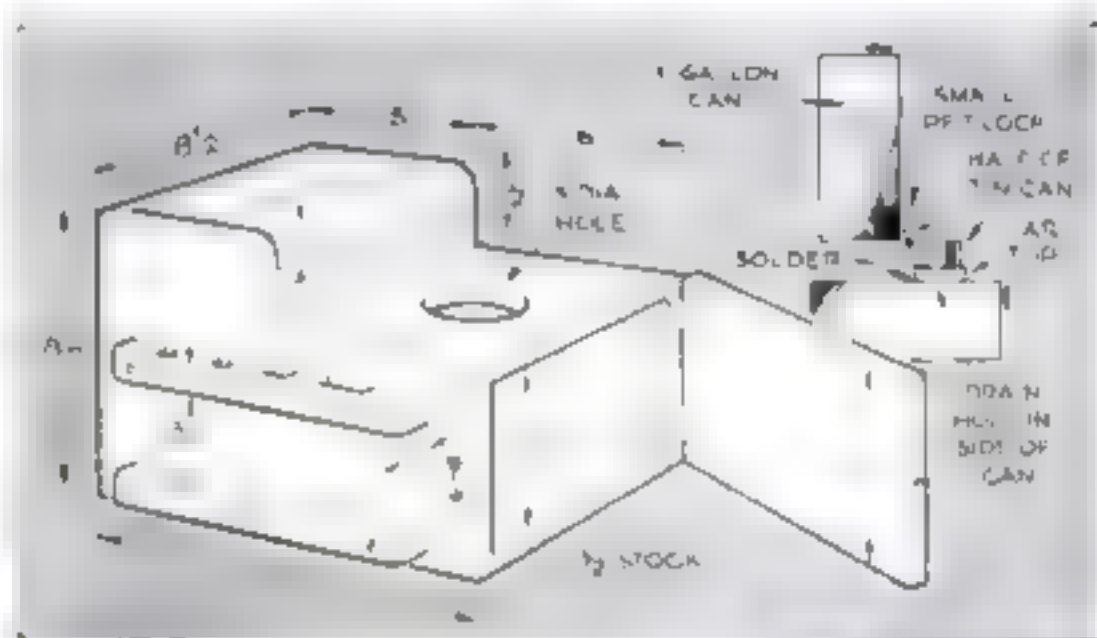
on the piano. Horizontal legs on these pieces just fit over the front lip of the sounding box. The angle between the upright and the horizontal legs is about 85 deg.—so music won't slide off. All metal touching wood is felt-covered.—**PAUL FACTOR.**



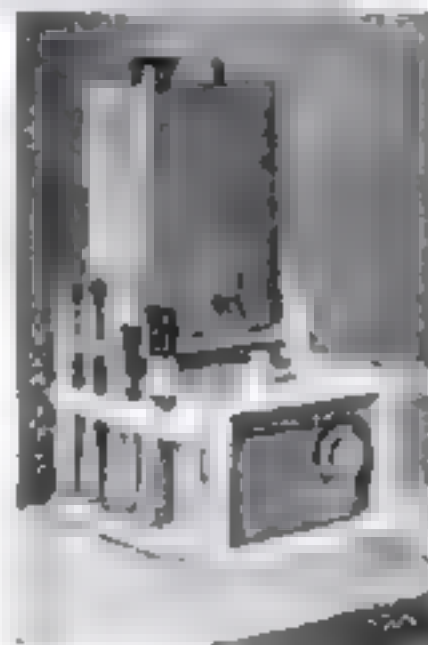
Simple Stand Supports an Outboard Tool Rest

DEPRIVED of an outboard tool-rest stand by wartime priorities and restrictions, I improvised one, as shown above. Using a small box as a form, I poured a concrete mix around a 4" by 4" upright. Then I drilled the upright to take the tool-rest hold-down bolt.—**K. M. MARTIN.**

Unit Cleans and Stores Paintbrushes



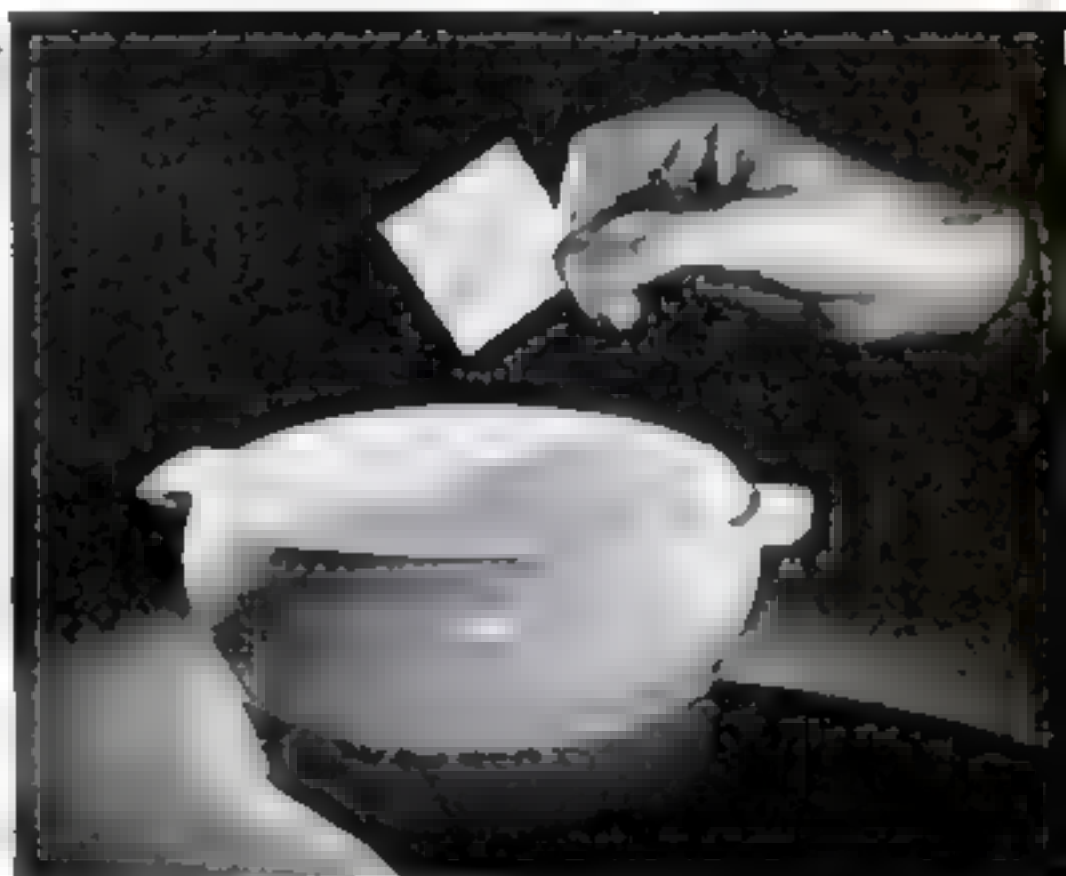
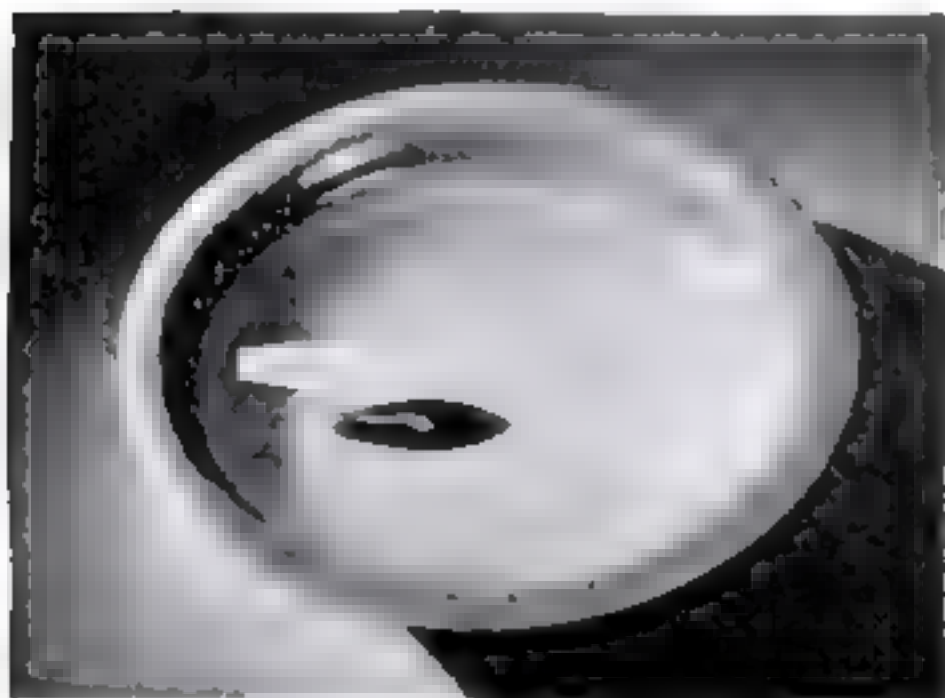
THE construction of this paintbrush cleaner and rack is shown clearly in the drawings and photograph. Remove the handle from the bottom can. Cut a 1 1/2" hole in one side and solder a screw-top jar ring over it. This ring lies below the hole in the casing and holds the lower half of an ordinary soup can. Fill the top container with three parts of lacquer thinner and one of alcohol. Clean your brushes in the small can, pour the cleaner into the bottom container, and set the can back in place to prevent evaporation. Use the cleaner over and over, straining it back into the top can through cloth.—**NEIL STILLMAN.**



After cleaning the brushes, wipe them with a rag and rack them as shown above

TABLE TRICKS

SAILING A CARDBOARD BOAT in a pan of water without touching or blowing on it may seem impossible, but it can be done. Slit the stern as shown in the photo below; then when you float the boat, put a drop of soapy water in the slit, and it will shoot ahead as if by magic! The soap lowers the surface tension of the water behind the boat, and the greater tension in front pulls it forward.



PICKING A NAME BLINDFOLDED from a bowl is easy if you train your fingers to "see" the right slip. Divide a square of paper 6" by 6" or smaller into nine parts by folding it twice in each direction. Write a name on the center square, tear the paper along the folds, and put all nine slips into the bowl. Blindfolded, you can pick the right one every time. Simply feel the edges of the slips—the only one to have four rough edges will be the one you want!



WHEN YOU OFFER a friend a cigarette from a pack, you can astonish him by making it appear to rise of its own accord. You need a pack with a cellulose wrapper. Put one cigarette between the wrapper and the pack and, without letting your finger be seen, press on the wrapper. Hold the pack at an angle.

IF YOU'D MAKE A HIT, pretend to bend one of your hostess's spoons to demonstrate the "flexibility" of modern metals. Then quickly "unbend" it before she faints! Close both fists over the handle, with the little finger hooked under it, as shown at right, and pretend to bend against the table. The illusion is perfect.



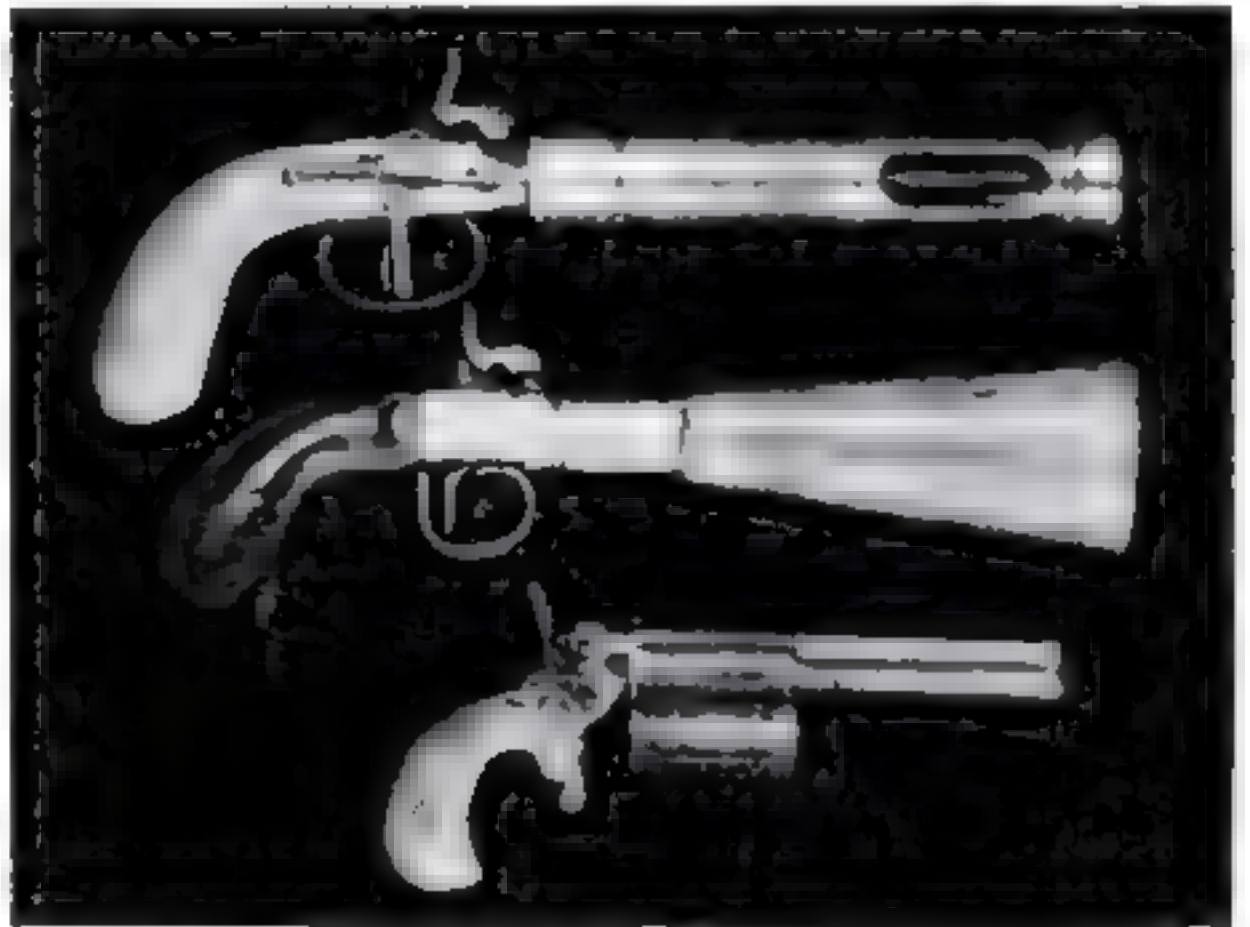
THIS SHELL GAME is in reverse. You can pick out the coin under the shell! Use a half dollar and milk-bottle caps, or another coin and caps slightly larger than its diameter. Turn your back while a friend covers the coin with a cap. The trick is to have a hair fastened unnoticed to the underside of the coin with wax so it will stick out under the cap!

Old-Time

MAGIC is indeed one of the ancient arts. It is mentioned even in the Bible, which records the attempts of the Egyptians to imitate with magic the miracles of Moses, and we have accounts, too, of the magicians of ancient Greece and Rome astonishing audiences with optical illusions.

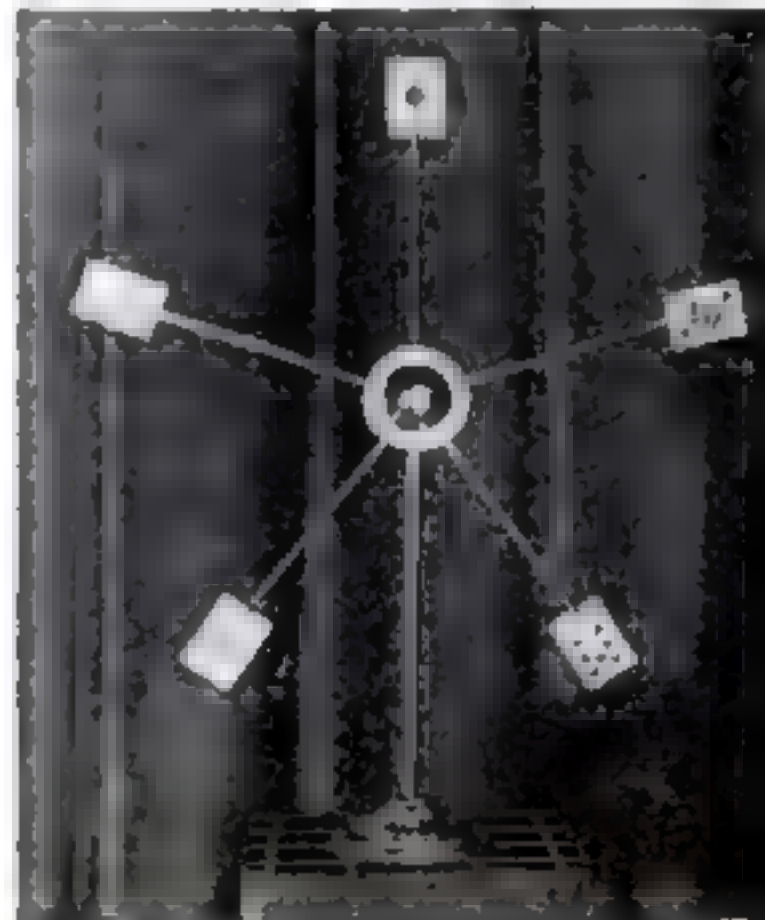
But it was the latter half of the nineteenth century that saw the golden era of stage legerdemain begin, following such inventions as that by Maskelyne in 1863 of

Set on a goblet, this skull with a hinged jaw rapped out "spirit messages" to spellbound audiences of two generations ago. It is part of the Levasser collection of magical effects now owned by John Snyder, Jr., shown below with a similarly performing hand



Pistols like these fired blanks to help the old-time magicians make articles vanish before audiences' eyes. Silk handkerchiefs stuffed in them would inexplicably appear in vases at which they were fired

Onlookers' questions were answered by the "spirit bell" (left below), its clapper mysteriously rising and falling. It was made in Germany. Picked cards appeared on the star (right) as a deck was thrown at it



Magic

HUGE COLLECTION SHOWS CONJURING DEVICES USED BY STAGE MAGICIANS OF YESTERYEAR

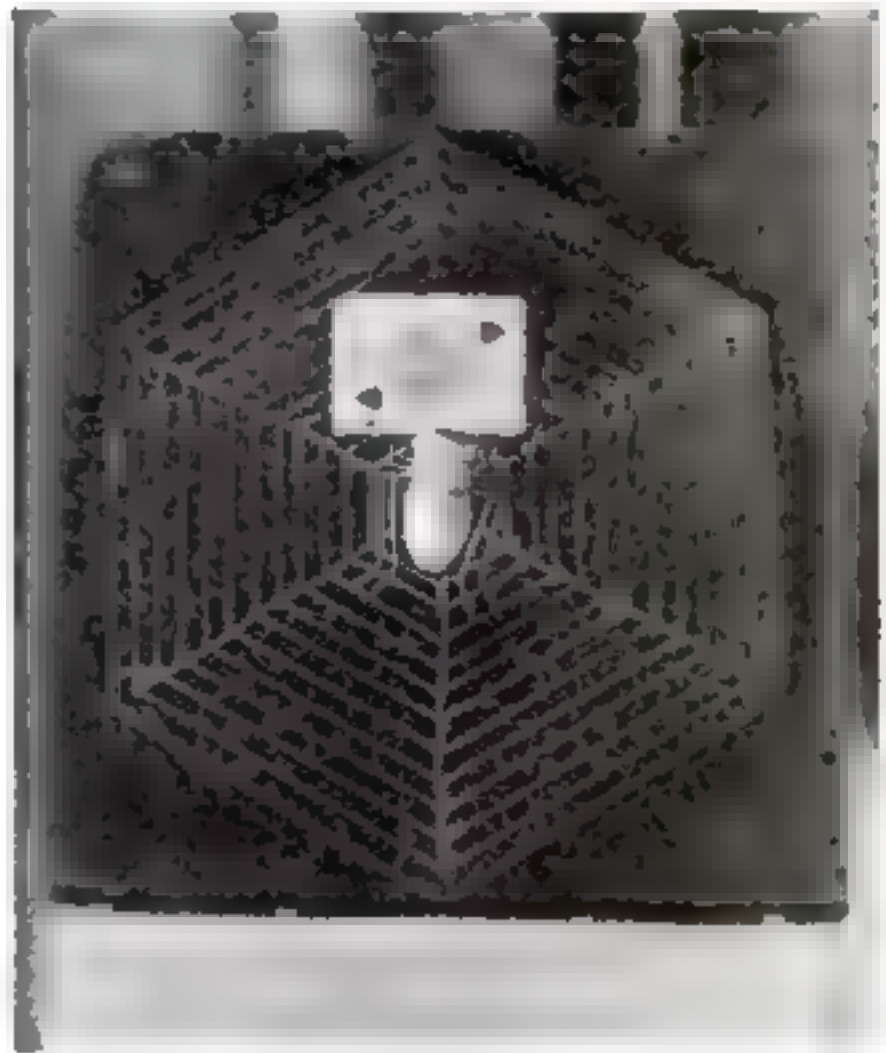
the wooden cabinet in which a person could be made to vanish. And it was in the early 1900's that Harry Kellar, Harry Houdini, and Howard Thurston flourished as successors of Herrmann the Great.

One of the finest collections of magical effects gathered during this period was that of Louis E. Levassor, who brought together some 5,000 items from all over the world. He exhibited them from 1910 to 1925 to many of the most famous exponents of the art, including Houdini and Thurston.

Some of Levassor's prized pieces are shown in the accompanying photos. The four cabinets in the photo below contain only a part of the collection which, after the death of Levassor's widow, was purchased intact by John Snyder, Jr., of Norwood, Ohio, a magician in his own right who now produces equipment for other magicians (see P.S.M., Sept. '44, p. 188).

Among the items that spellbound audiences of two or more generations ago is a skull with a hinged jaw that raps out "spirit" messages while on an upturned goblet, seemingly beyond the control of any mortal hand. A "spirit hand" and a "spirit bell" perform similarly.

One of Levassor's effects, a card star, dates from before 1880. Five selected cards appear magically on the arms as a complete deck is thrown at the center disk. Most ingenious is a magic spider on a web of gold braid that turns on a hidden axle. A picked card, replaced in the deck, magically grows little by little into view as the web spins.



This web of gold braid stitched on a black-velvet hexagon produced a selected card apparently from nowhere as it spun on a concealed axle. The card, chosen by someone in the audience and disposed of with the deck, appeared little by little, finally coming within the grasp of the spider. Even to those now in on the secret, the effect is magical.

These four cabinets, built by Snyder in his shop, hold part of the Levassor collection. The boxes and vases were used to produce vanished articles.



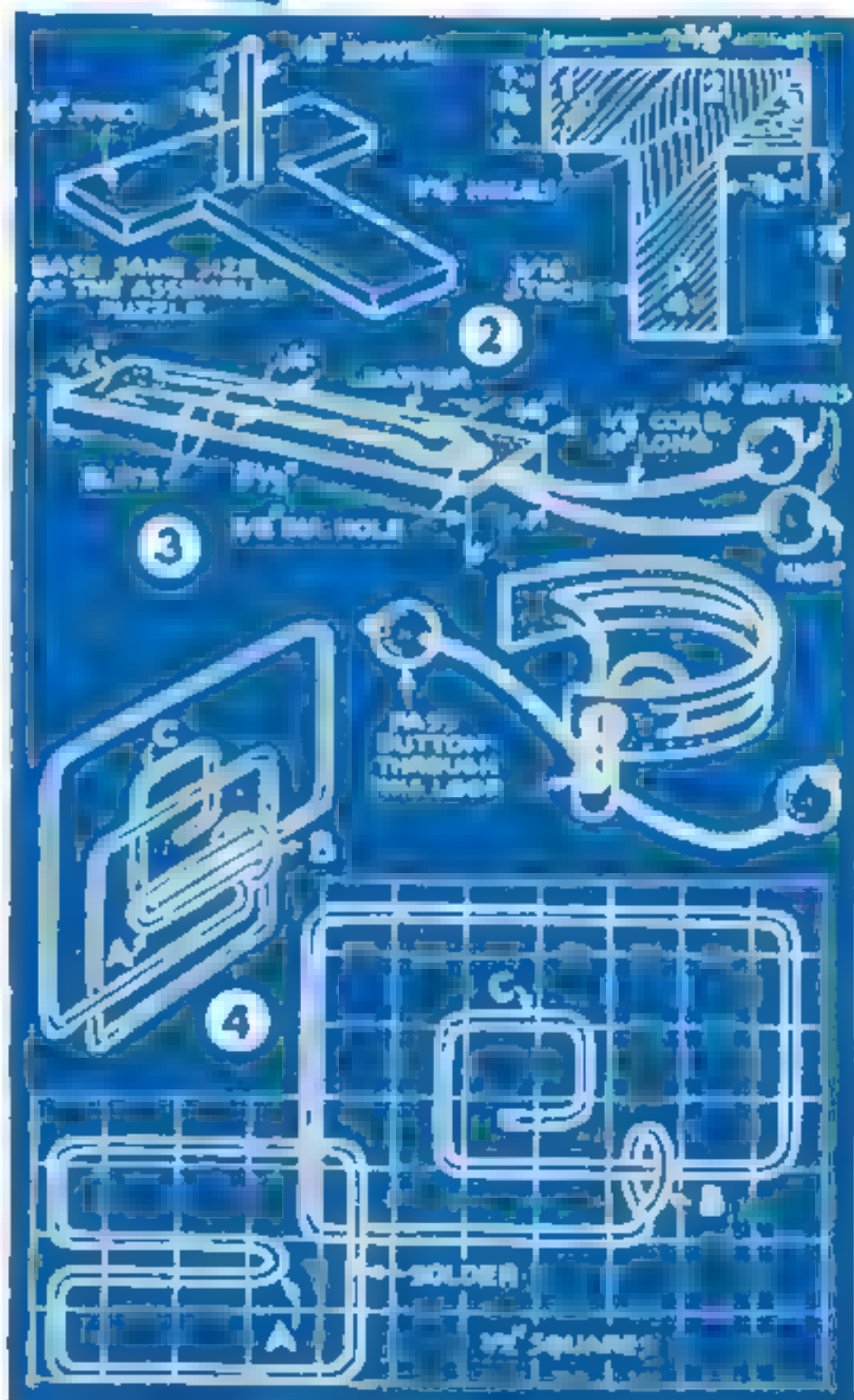


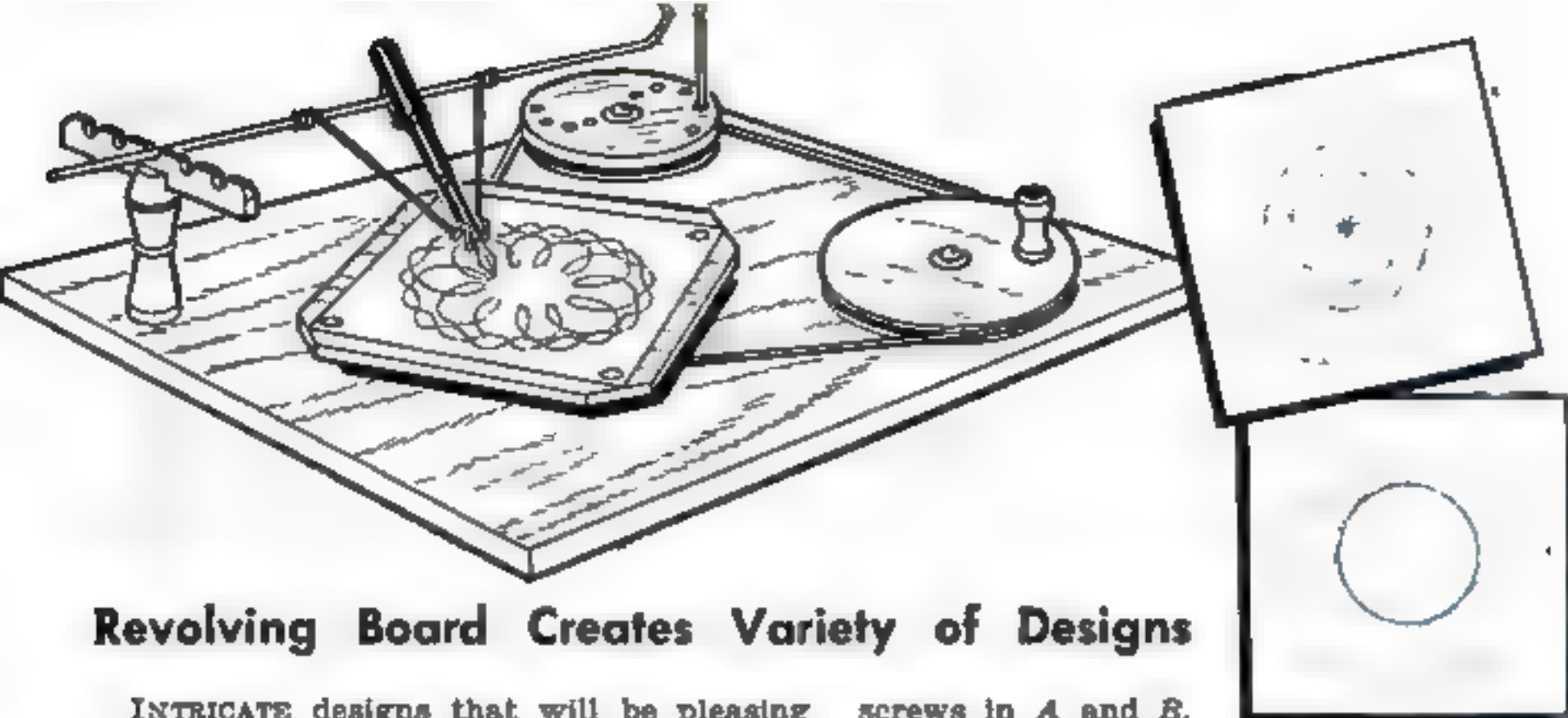
1 DEFY GRAVITY with this variation of a common trick. Rub the mouth of a ridged tumbler on emery cloth to get a rough, plane surface and drill a hole with a brass tube and valve-grinding compound, as shown at left. Hold your thumb over the hole, fill the glass, cover it with the previously dampened cardboard and celluloid, and invert it. The water won't spill. Now slide the square off, leaving the invisible disk. The glass stays full. Then, over a sink, utter a magic word, move the thumb, and the glass empties.

2 TO ASSEMBLE A T from four pieces, as shown in the drawing, requires more concentration than you would believe. Saw the T out of 3/16" wood stock as indicated, making all edges straight, and drill each piece to fit over a peg in a companion T that serves as an ornamental base to hold the puzzle when it isn't in use. Enamel the base and each piece a different color, or shellac them. In the latter case, vary the grain to avoid giving away clues.

3 HOW TO REMOVE THE CORD from the slit leather strap is a real brain teaser that will make most of your friends give up. Then they will feel foolish when you show them how simple it is. Of course, you pull the 1/4" wide leather strip through the 3/4" hole, and *don't* try to force the 3/4" buttons through! Use a strong, pliable leather, and dress it occasionally to prevent drying out.

4 ODDLY BENT LOOPS joined as in the bottom drawing provide an interesting problem when you try to separate them. Make them of coat-hanger wire, and have bend A small enough to fit into loop B. To solve, slip A into B as shown, work spiral C through A, and draw A back through B.





Revolving Board Creates Variety of Designs

INTRICATE designs that will be pleasing to the budding young artist, or will be of interest to any boy or girl, are possible with this modern version of a device that once fascinated our grandparents.

Plywood or board that will not warp should be used for the table and for the top section glued on pulley C, but solid stock is preferable for the pulleys themselves. A method of turning the three pulleys at one time on the faceplate is shown below.

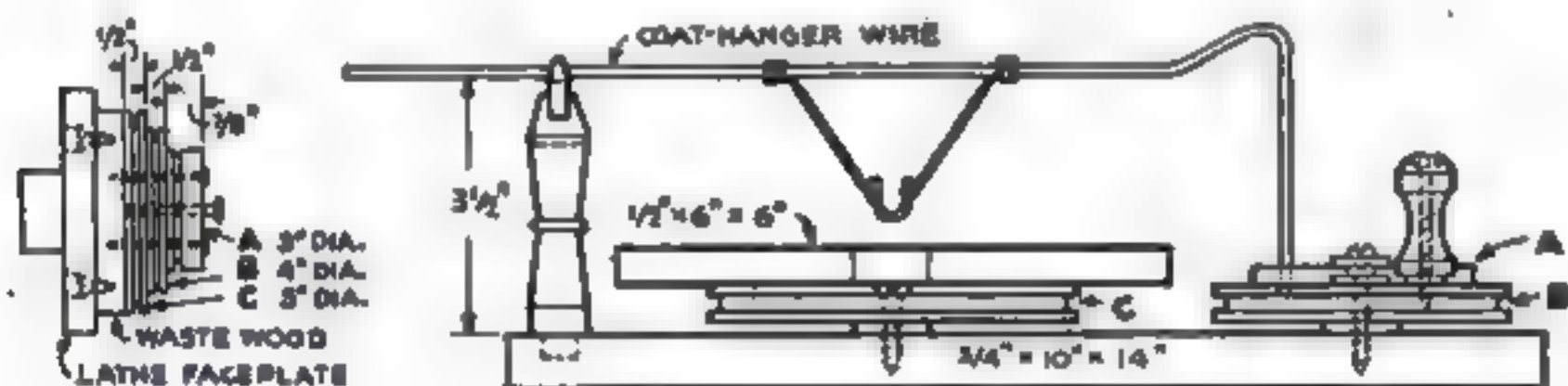
Mount the pulleys with washers next to the table and under the heads of the pivot

screws in A and B.

Drill the hole clear through the knob on

B so the knob will turn. The holes in A are all at different distances from the center. A heavy rubber band makes a good belt.

Spring wire is required for the yoke holding the pen. The U should be bent as shown to form a spring clamp. Wind the ends on the wire guide tight enough to bind when spread slightly, yet not so tight as to prevent sliding when the position of the pen is to be changed.—JOHN W. DEAN.

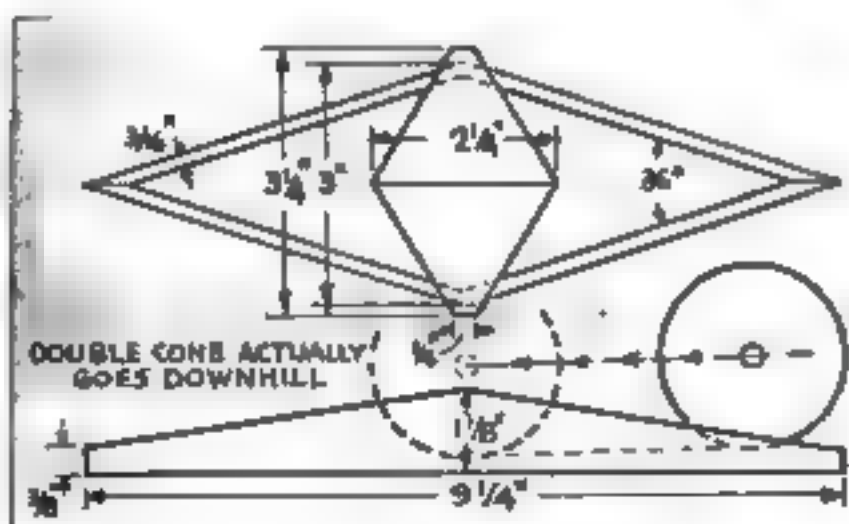


Novel Cone on Diamond-Shaped Track Appears to Run Uphill

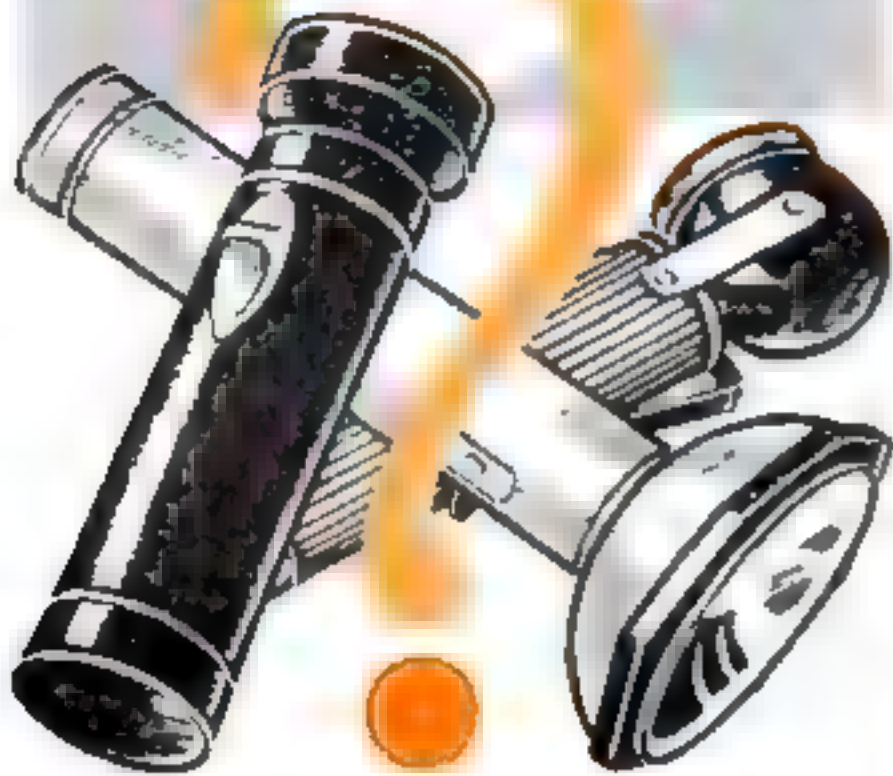
HERE is an amusing contrivance that will puzzle your friends by its apparent defiance of gravity. When placed at either end of the diamond-shaped track, the double cone will immediately roll to the center, seemingly going up the incline.

What happens, of course, is that the cone

actually rolls downhill, since it is actually at its lowest point when at the widest part of the diamond, but the illusion is amazing. Take care in turning the cone so no flat spots will act as brakes. The original shown here was made by boys of the Metropolitan Junior Achievement, of New York.



CAN THAT FLASHLIGHT BE FIXED



By HAROLD P. STRAND

THERE is no reason for throwing that old flashlight away just because it doesn't work. Now that we have become accustomed to conservation, even if replacement of some articles is growing easier, a lot of satisfaction can be derived from repairing things we would once have discarded.

Like any other mechanical object, a flashlight can be serviced if you know what to look for. Some repairs are a simple matter of adjustment; others may be more difficult; but in no case are expensive materials or tools required, and in any event it is fascinating for the craftsman to hunt around and finally spot the defect.

Prewar flashlights all operate on the same general principle whether they have metal or fiber cases, and even the newer plastic ones, though differing somewhat in construction, follow the same general lines. Metal cases, being able to conduct electricity, carry current from the end of the lower battery cell through the large spiral spring in the base cap to one side of the switch, which may be either an electrical or mechanical type, as illustrated at A and B in the drawings on the facing page. Fiber-case flashlights (C in the drawing) may have either type of switch, but the plastic models (shown at D) usually are mechanical.

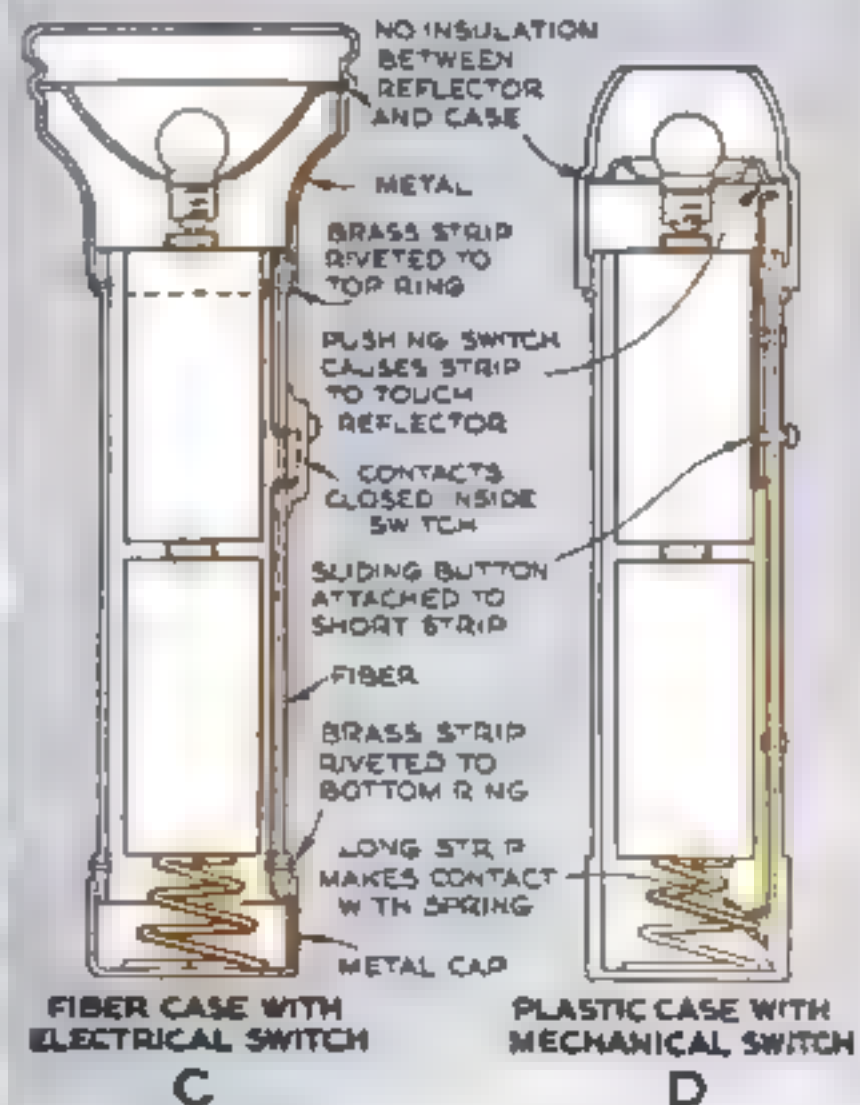
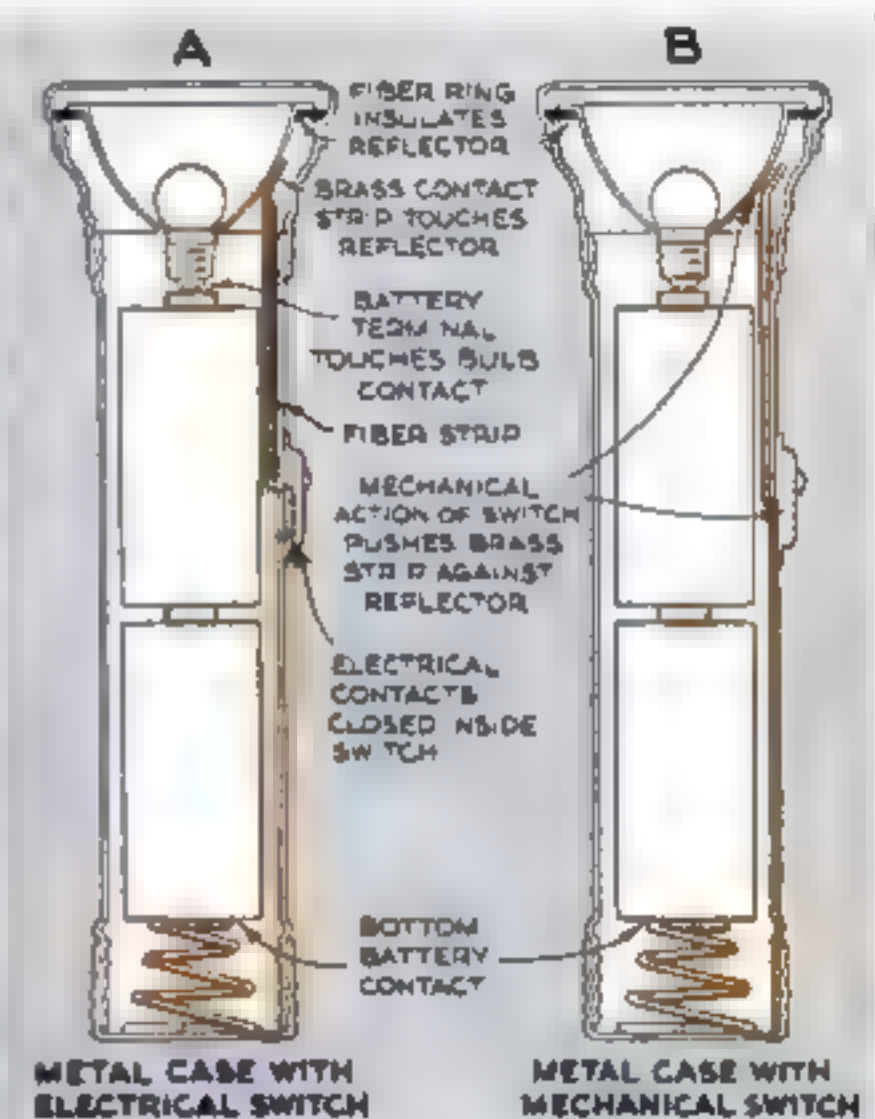
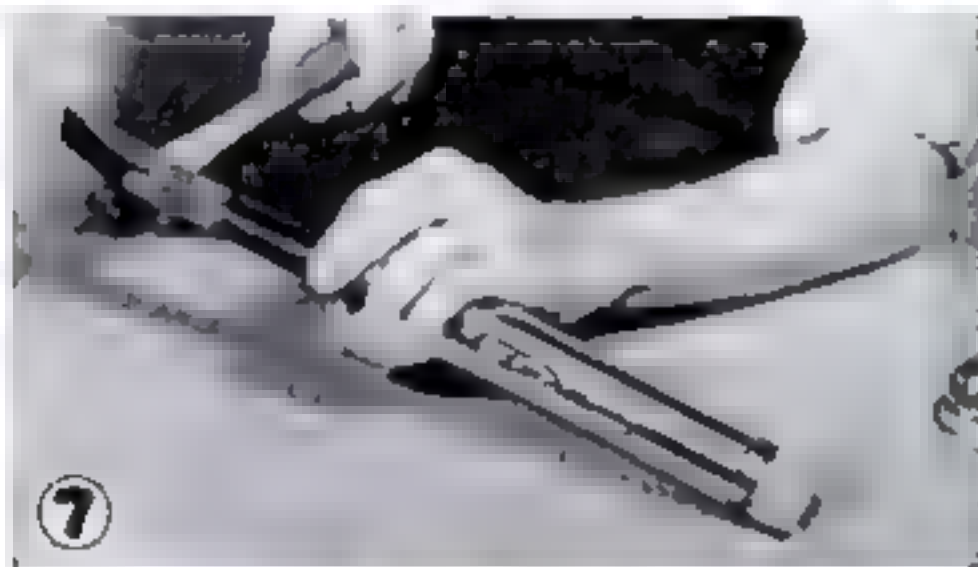
A brass strip inside the case connects the

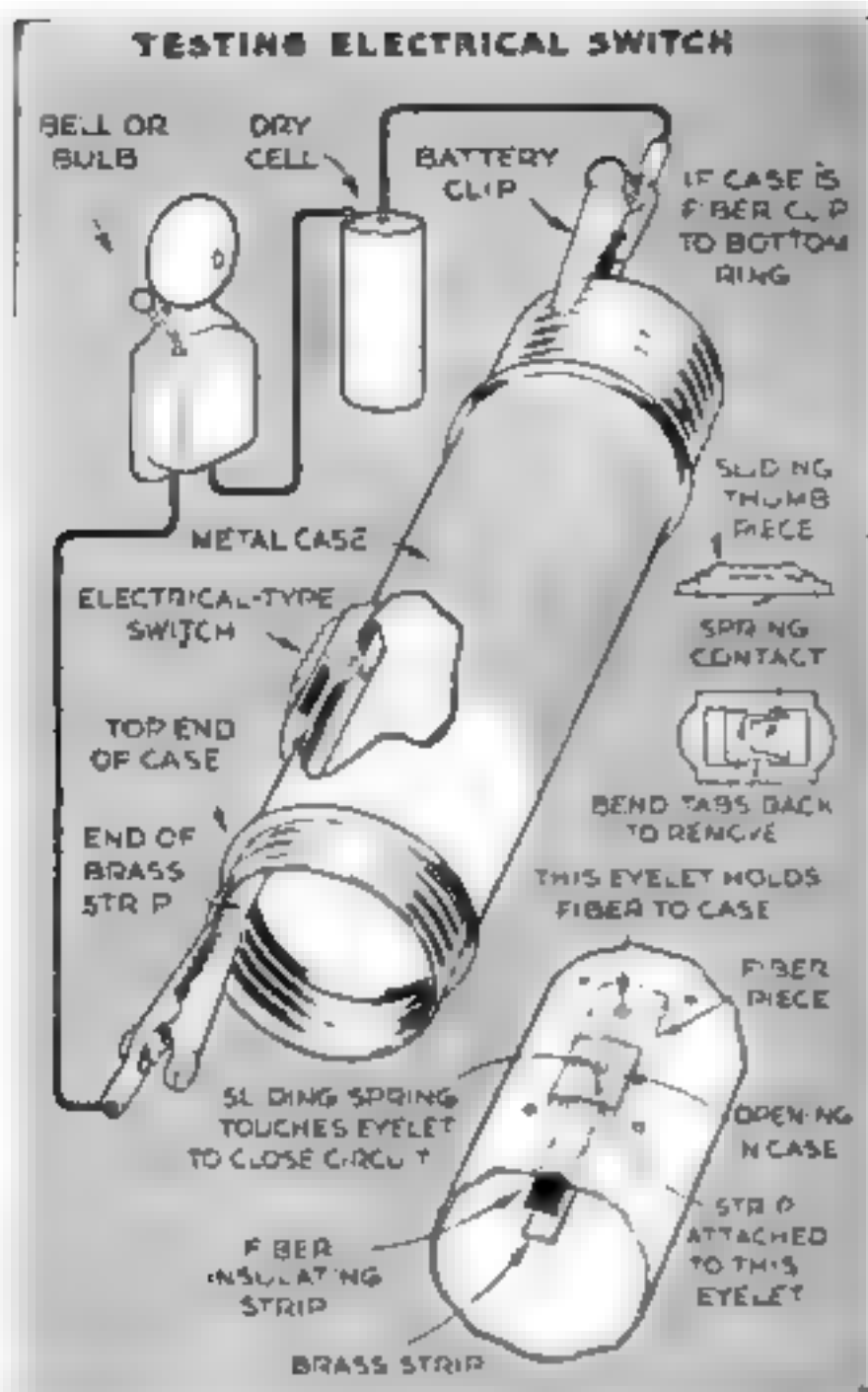


second side of an electrical switch to the reflector, as shown, and in a metal case a piece of fiber insulates it from the case. This insulation is unnecessary in a fiber case. The lamp screws into the reflector, and its center contact touches the positive terminal of the top battery cell. Pushing the switch completes the circuit. The mechanical switch operates by sliding the brass strip, making or breaking the connection when the strip touches or is pulled away from the metal reflector.

Regardless of the type of switch, the reflector is insulated from a metal case by a fiber ring to keep the lamp from lighting except when the switch is closed. This is unnecessary in a fiber or plastic case.

The first step in servicing any flashlight is to test the lamp and battery cells. With a piece of bare copper wire wrapped around the base of a lamp to form a screw socket, touch the center contact of the lamp to the positive (top) terminal of a battery cell and the other end of the wire to the bare lower





end of the cell, as in Fig. 1. If both lamp and cell are good, the lamp should light. To make the test, you must know, of course, that at least one is good at the start, so begin with a lamp from a working flashlight or have a dealer make the tests if you fail to get a light with any combination.

A lamp rated at 2.2 to 2.5 volts is correct for a two-cell case and should light to about half its usual strength on a single cell. If the light is dimmer than this, the cell is weak, and if the lamp does not light, the cell is dead. Three-cell flashlights require 3.2 to 3.8-volt lamps, and they light very dimly on a single cell, but for test purposes, if one lights at all, it and the cell can be assumed to be good. Use the correct lamp when re-assembling the flashlight, for a 3.8-volt lamp will not light at full strength in a two-cell case, while a 2.5-volt lamp will light brilliantly in a three-cell case but will soon burn out.

If good cells and a good lamp won't make the flashlight work, check all points of contact beginning with the spring in the base cap, removing this part and cleaning it of corrosion with emery cloth, as in Fig. 2. Many plastic cases do not have a base cap that can be removed, in which case the spring may be cleaned with an emery stick of the kind used for manicures or with a

disk of emery cloth cemented to a dowel.

Should the flashlight still refuse to work, remove the lens cap and reflector and clean the brass contact strip (Fig. 3) and the reflector (Fig. 4) with fine sandpaper to assure a good contact. Examine the fiber insulation between the contact strip and a metal case (Fig. 3), and make adjustments or provide a new strip of fiber if it does not insulate properly.

Try out the switch and note whether the brass strip slides or remains fixed. If it moves, it is mechanical in action, and the end should be adjusted to clear the reflector when the switch is in the back position and to touch when pushed forward. The end of a strip that does not move—which indicates an electrical switch—should be adjusted to make firm contact with the reflector at all times.

Some flashlights take lamps that have a flange instead of a screw base. The flange is held between two parts of the lamp receptacle, which must be unscrewed, as in Fig. 5, to release the lamp. Both the metal surface inside this receptacle and the spring should be cleaned for good contact. The spring may require adjustment to touch the center contact on the lamp base. Flanged lamps can be tested in the wire socket used for those with screw bases.

If a faulty metal-case flashlight goes on and off without operation of the switch, there may be breaks in the insulating ring around the reflector. This should be examined in any case when a metal flashlight is being serviced. Two turns of $\frac{1}{4}$ " wide adhesive tape around the edge of the reflector (Fig. 6) can be used to replace the fiber. Press the tape down smoothly all around and apply two coats of shellac.

A broken or badly fitting lens can also be responsible for a short circuit. The lens ring, when screwed down, is supposed to hold the lens and reflector in their correct places, and if the lens does not fit properly, it may allow the reflector to shift and either touch the brass contact strip on a mechanical switch or pull away to where contact cannot be made. In either case, replace the damaged lens.

If you have put your flashlight away without removing the discharged cells—a piece of carelessness that may result in permanent damage to the case—you may find that chemical action has caused the cells to swell so that they cannot be readily removed. Cut a 10" length of hardwood dowel about 1" in diameter and use it to drive out the cells, as shown in Fig. 7. They may start hard, and in some cases you may not be able to drive them out. An old auger bit can be tried as a last resort, but care must be used to avoid damage to the contact strips inside the case.

Once a hole is carried through, the cells can be pushed out easily.

Clean the inside of such a case with sandpaper on a round stick to remove all corrosion. Then wipe inside with a rag soaked in bicarbonate of soda to neutralize the acid effect of corrosion. Let the case dry before putting it back into service.

If the brass contact strips have been damaged by removal of the cells or by corrosion, cut new strips from .010" sheet brass. Folder the ends to the points originally riveted or use new rivets or eyelets.

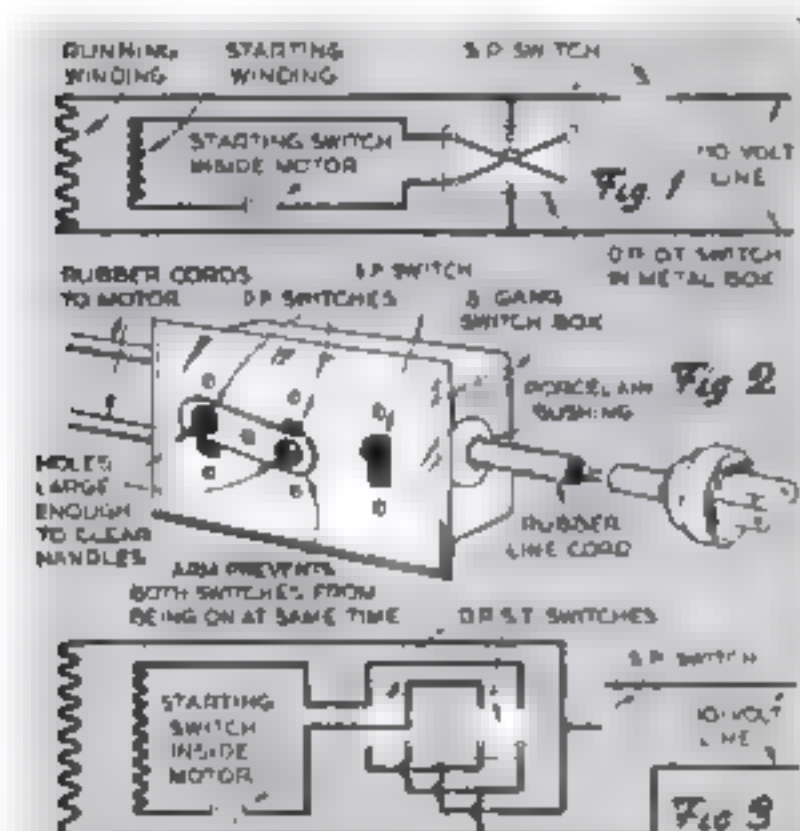
Mechanical switches rarely get out of order, but sometimes electrical-switch contacts won't touch or a contact spring breaks. Removing a switch is difficult and replacement is as hard, but both can be done. Test the switch first by connecting it in a bell

circuit as shown in the drawing on the facing page. If the switch is all right, the bell will ring when the button is pressed.

Use a thin, sharp chisel (Fig. 8) to cut the rivets holding a faulty switch, taking care not to damage the case or the switch flange. The bronze-alloy contact spring on the inside of most electrical switches will have to be replaced if it is broken, but in most cases the tension can be adjusted by bending the spring with tweezers, as in Fig. 9, so it will make contact with the eyelet holding the contact strip as shown in the drawing.

To replace the switch, insert new rivets and head them on a short length of 1" pipe or bar stock used inside the case as an anvil. Test the switch in the bell circuit to see that the repair is satisfactory.

Switch at Bench Controls and Reverses Split-Phase Motor



SMALL A. C. motors having separate leads brought out for the starting and running windings, or with terminal posts connected to each separately, can be controlled and reversed at the bench with one of the two switch connections shown in the drawing.

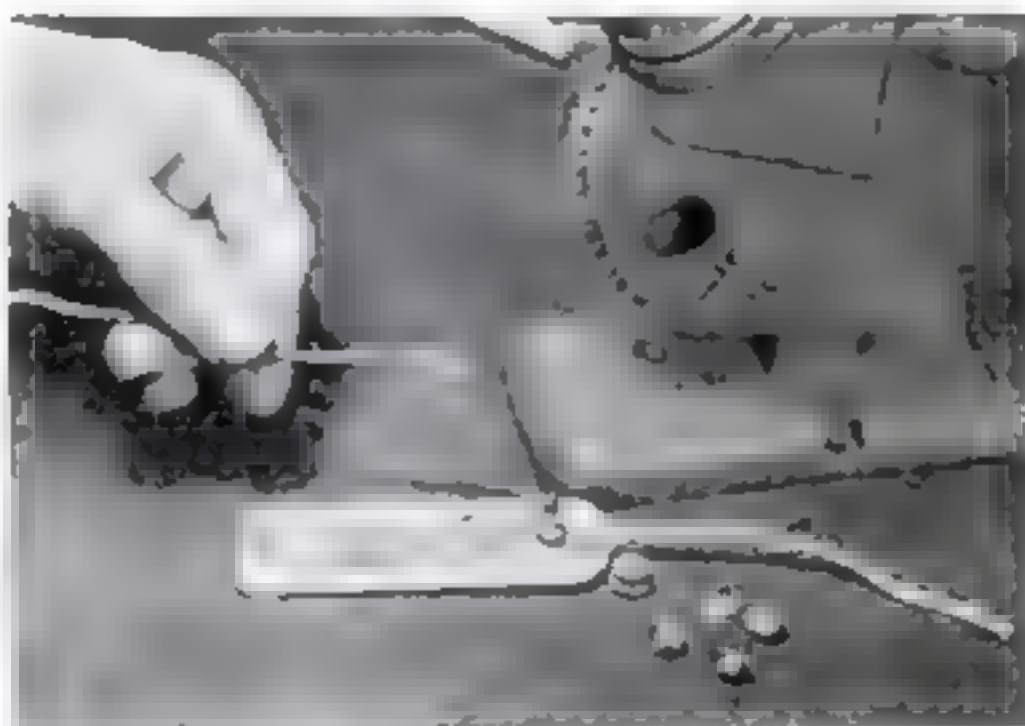
Reversal can be effected with a double-pole, double-throw switch connected as in Fig. 1. A single-pole switch starts and stops the motor. Cover the live contacts by enclosing the switches in a metal box.

For a neater job, build a metal control box or use a three-gang surface-type switch box (Fig. 2) and mount one single-pole and two double-pole toggle switches in it, connecting them as in Fig. 3. The single-pole switch controls the motor and the other two the direction. To prevent blowing a fuse, pivot a metal arm as shown so moving one double-pole toggle will move the other to the opposite position.

Eyelet Soldered to End of Wire Is Useful in Radio Work

WHEN wires are to be connected to bolts and removed occasionally, as required in experimental radio and electrical work, metal eyelets on the ends will be a convenience. Brass eyelets of the kind carried by stationery stores serve admirably.

Solder the end of the wire, if it is in strands, loop it to fit around the eyelet, and crimp the eyelet with a machine like that shown in the photo or with a blunt-nosed center punch or any round-nosed tool that will spread the metal around the wire. For absolute certainty of contact, coat the eyelet and the wire with solder.—W. E. B.

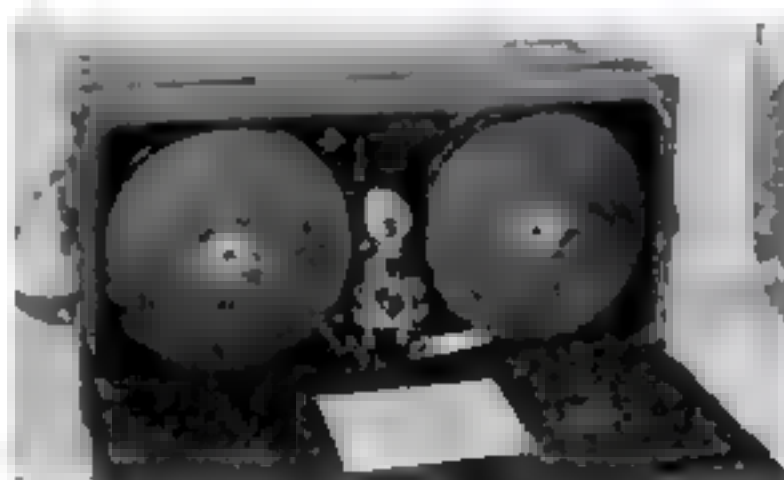
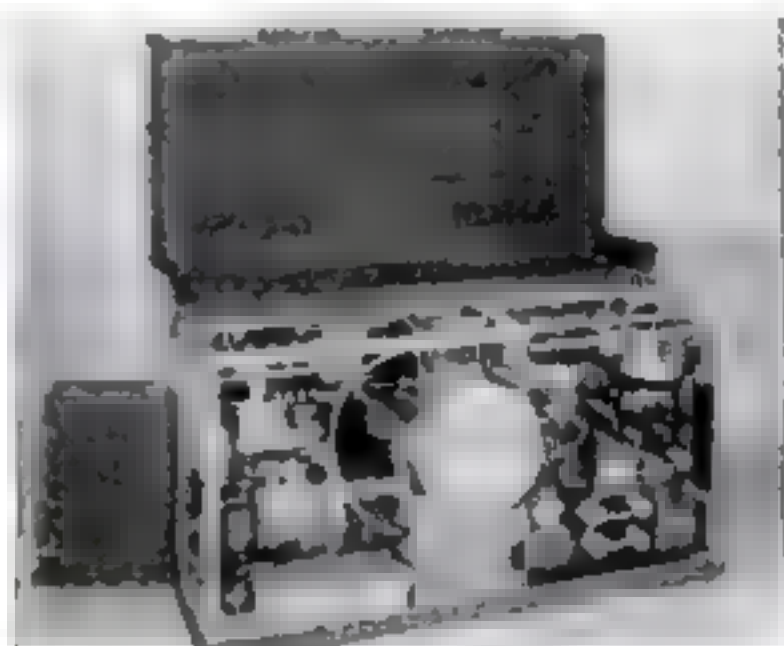


radio ideas

RECORDING BATTLE SOUNDS is possible with portable field equipment operated in synchronization with a 35-mm. camera. The apparatus, including camera-motor, film, recorder, accessory, and battery units, is carried in six cases, the largest 10" by 13" by 26". Complete, it weighs 392 lb. It was developed, on request from the U. S. Army Pictorial Service, by Wesley C. Miller, M-G-M engineer, and others in the Academy of Motion Picture Arts and Sciences.



With portable equipment in half a dozen cases, Army cameramen can record battle and other sounds in synchronization with their front-line movies

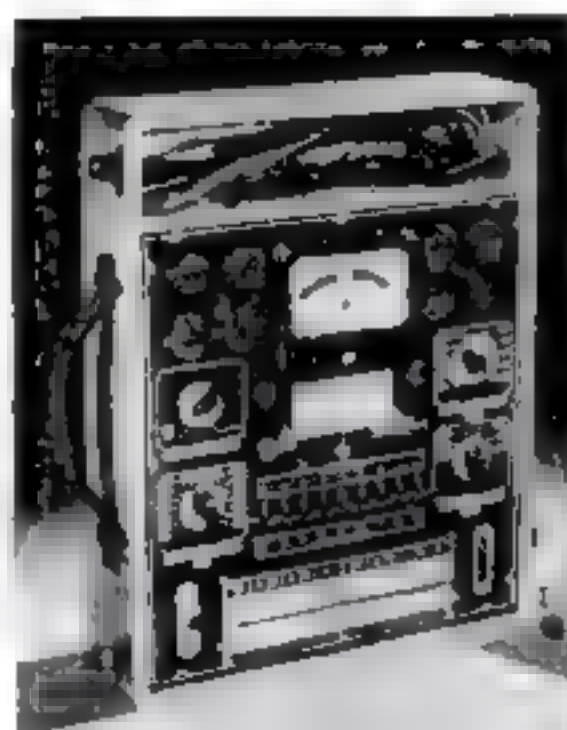


Above, top, the control panels on the lid of the recorder unit (center), which houses all operating parts. Another view of it is shown directly above



VEST-TYPE WALKIE-TALKIES adapted from developments in radio for the armed services have been designed by the Police and Emergency Communications Section of RCA Victor. Two-way communication between foot and traffic policemen and their headquarters is expected to be improved by new circuits, tiny tubes, and better antennas.

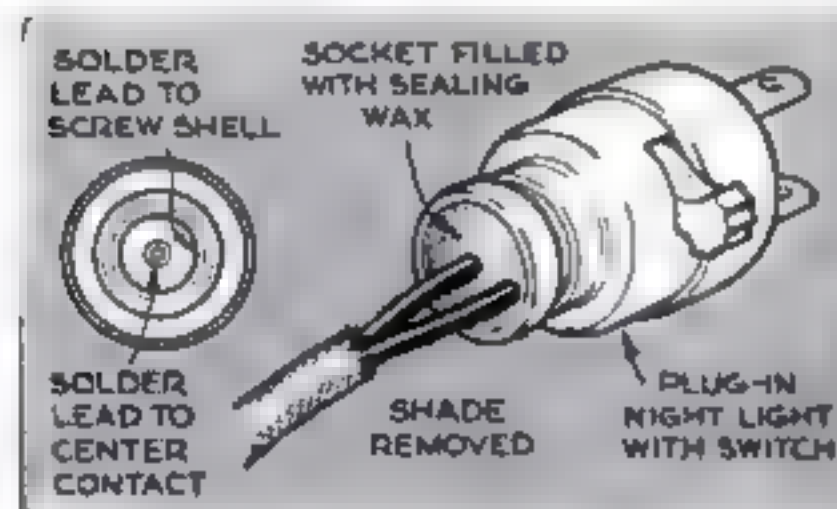
A NEW TUBE TESTER housed in a carrying case measuring 8" by 13" by 14 1/4" and weighing only 12 1/4 lb. has been devised for simple and speedy operation. It handles a wide variety of tubes including midgets and all acorn types, and has a filament-voltage testing range of from 1.1 to 117 volts. Lever switching controls each tube prong. The tester is made by Radio City Products Co., New York.



Servicing Your Radio

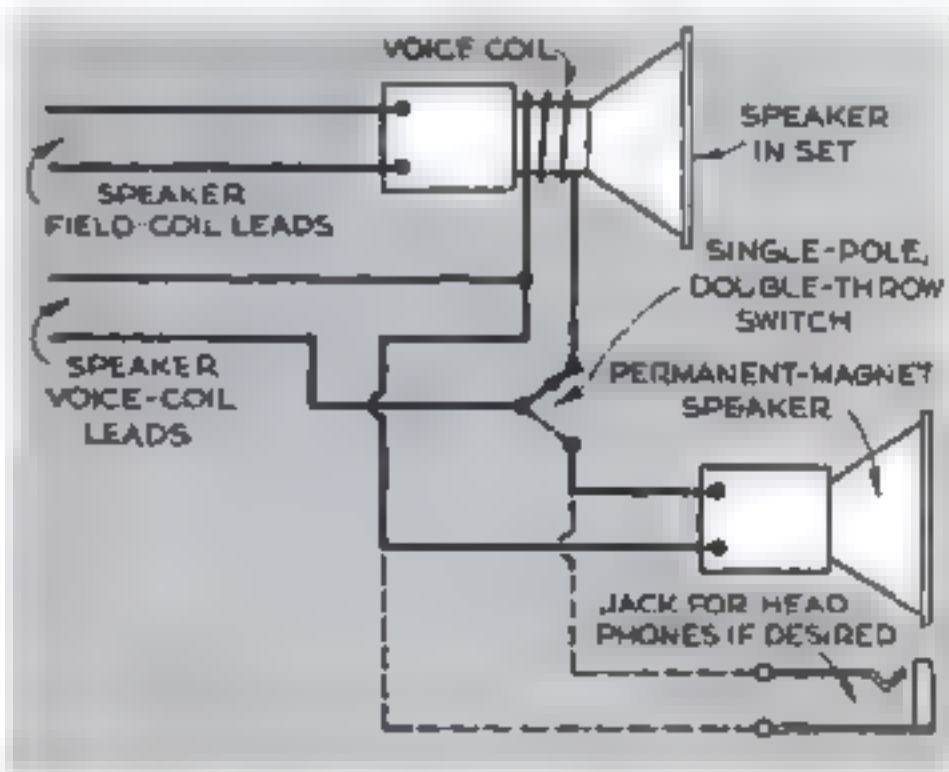
WHEN THE VOLUME CONTROL of a small A.C.-D.C. receiver becomes inoperative, it may be found difficult to obtain a replacement with a built-in switch. If so, an ordinary volume control may be installed and the broken side of the supply line inside the set soldered together and taped.

To provide a way to shut off the receiver, the conventional plug may be removed and the two cord leads soldered, as shown below, to the interior socket contacts of a plug-in night light equipped with a switch. The covering over the insulation should be taped down neatly, after which sealing wax may be poured into the socket. Such a switch control is convenient only when it can be plugged into a waist-high receptacle. Its current-carrying capacity limits it to small table sets and the like.



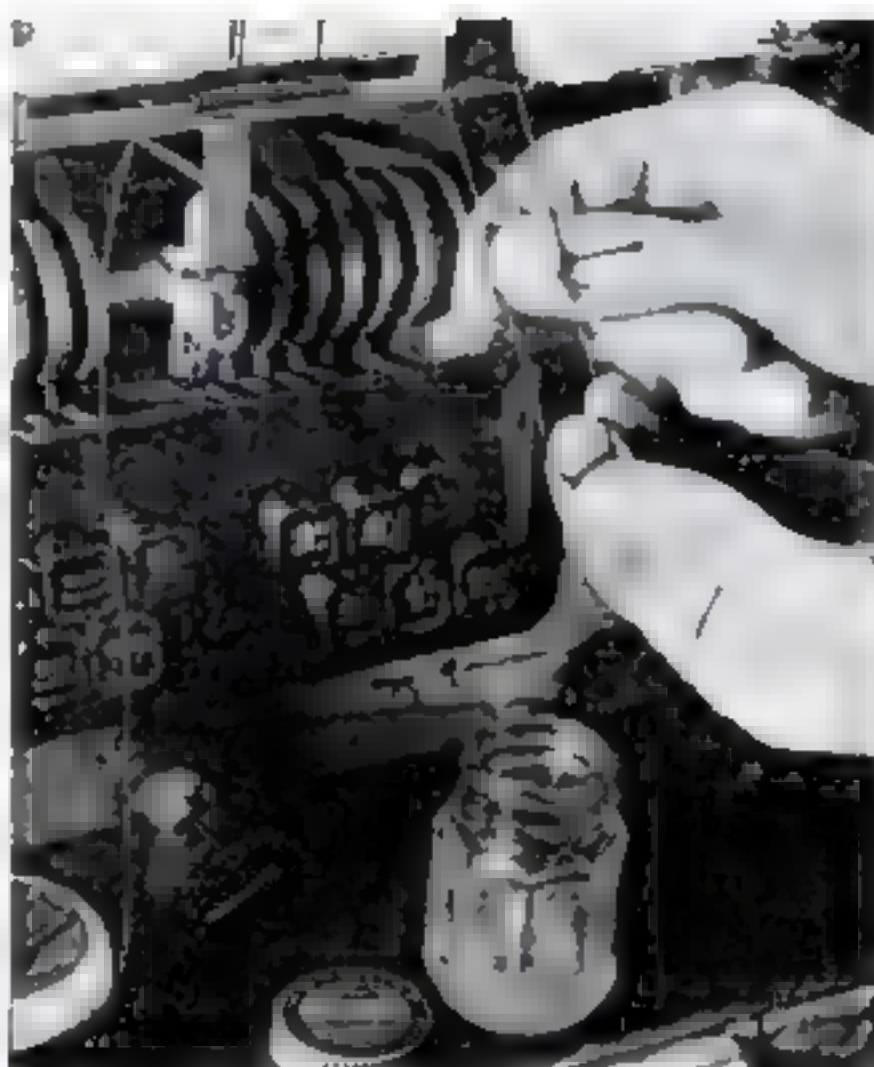
AN ADDITIONAL SPEAKER of the permanent-magnet type for use in a kitchen, bedroom, or basement shop may be connected to your present receiver, as shown at the right, by placing a single-pole double-throw switch near or on the set. The switch may be a telephone-switchboard key or one of a similar type that provides good contact, or it can be a double-pole double-throw switch with only one side used. A jack for headphones may be installed similarly.

The operating switch cuts off one speaker and turns on the other. If possible, use a switch that cannot leave both circuits open.—FRED PRESTON.



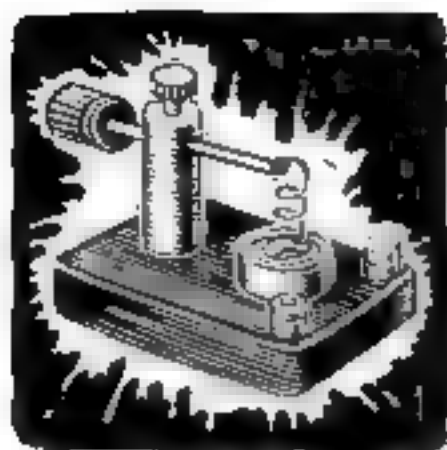
FREQUENCY-TEST RECORDINGS are available for spotting circuit and apparatus resonant peaks in a phonograph and showing up defective pickup units. They are 12" records for use on standard equipment.

RCA Victor has one that sweeps slowly from 10,000 to 40 cycles with signal clicks to mark even thousands and hundreds. Co-



BROKEN DIAL CORDS and those on pointers can be replaced with heavy fishing line, such as 18-lb. test line, as shown above. The new cord may be kept pliable, and made to last considerably longer, by lubricating it with petroleum jelly at points where it passes through grommets or rubs against another part of the receiver.—W. E. B.

lumbia has several recordings of single-tone frequencies. One gives even thousands, hundreds, and tens from 10,000 to 50 cycles. On another, vocal announcements identify frequency. A third has a fast sweep from 10,000 to 40 cycles, then noise spectrums of all simultaneously from 40 to 14,000 followed by limited-range spectrums.—J W.C.



RADIO DETECTORS

By
**John W.
Campbell, Jr.**

IN RADIO parlance, the circuit in a receiver that strips incoming high-frequency waves of the audio impulses of speech and music they carry is usually referred to as the "detector" circuit. Actually the word "demodulator" would be more accurate, for a detector is any device that will reveal the presence of electro-magnetic radiation, whereas a demodulator separates the modulated signal from the carrier wave.

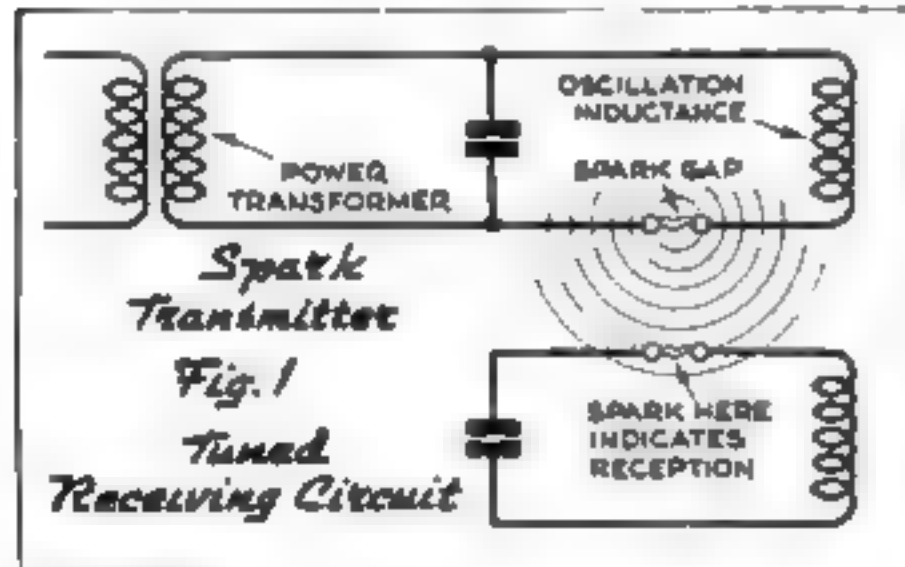
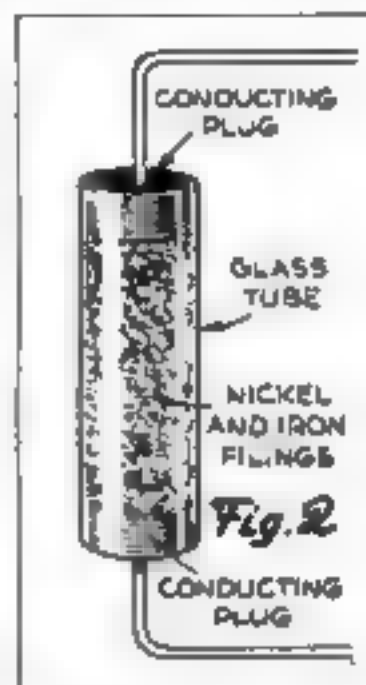
When Hertz sought by means of the first radio-frequency experiments to prove the existence of the electromagnetic waves indicated by the equations of Clerk Maxwell, he first had to devise a way of generating the radiations. The spark-gap oscillator answered that problem—he hoped. Hertz also needed a detector that would tell him if this theoretical electromagnetic energy was in fact present. The first detector was

it would turn on a local current when controlled by a distant signal. But it wasn't particularly sensitive, and the filings had to be "decohered" or loosened up, usually by a clapper device, before it could react to a new signal. It was thus suited only for code communication.

Next in order of simplicity after the coherer was the crystal detector, a circuit of which is shown in Fig. 3. The property of certain crystals, notably galena (sulphide of lead), of converting R. F. oscillations into uni-directional current was discovered early in this century. Though devised later than other, more effective detectors, crystals had the advantage of simplicity, low cost, and fidelity.

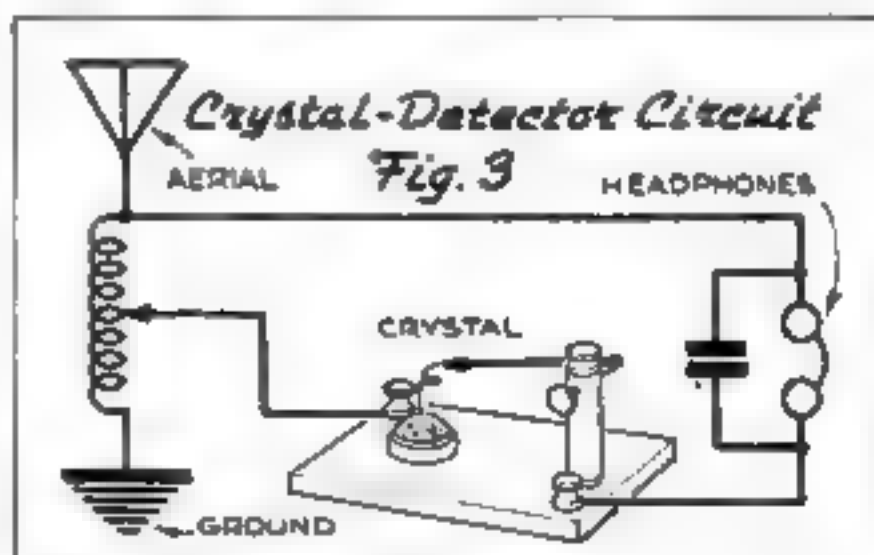
The operation of a crystal set is simple. The incoming R.F. (A in Fig. 4) is sent through a crystal which offers substantially more resistance to current flowing in one direction than in the other. The result, as indicated in B, Fig. 4, is a direct current, still pulsating at high frequency, with wave amplitudes that correspond to the audio modulation impressed on the R.F. When this current is applied to a pair of earphones, the diaphragms cannot follow the rapid R.F. pulses, but they can respond to the much lower frequency of the change in amplitude of the R.F.—that is, to audio modulations, shown at C.

Precisely why a galena crystal can offer differential resistances to A.C. has not yet been satisfactorily explained. Scientists believe that its action is related to barrier-layer rectification, another imperfectly un-



simply a tuned circuit, matched to the transmitter. In their earliest form, Hertz's circuits were similar to those shown in Fig. 1; when powerful oscillations were set up in the transmitter, somewhat weaker oscillations were built up in the nearby detector circuit and a smaller arc leaped its spark gap.

Stimulated by Hertz's proof of the existence of electromagnetic waves, other scientists discovered new ways to detect them. Iron filings, it was found, tended to clump together in the presence of radio waves, and would then conduct a local current more readily. The result was the coherer (Fig. 2), which was in effect a crude amplifier, since

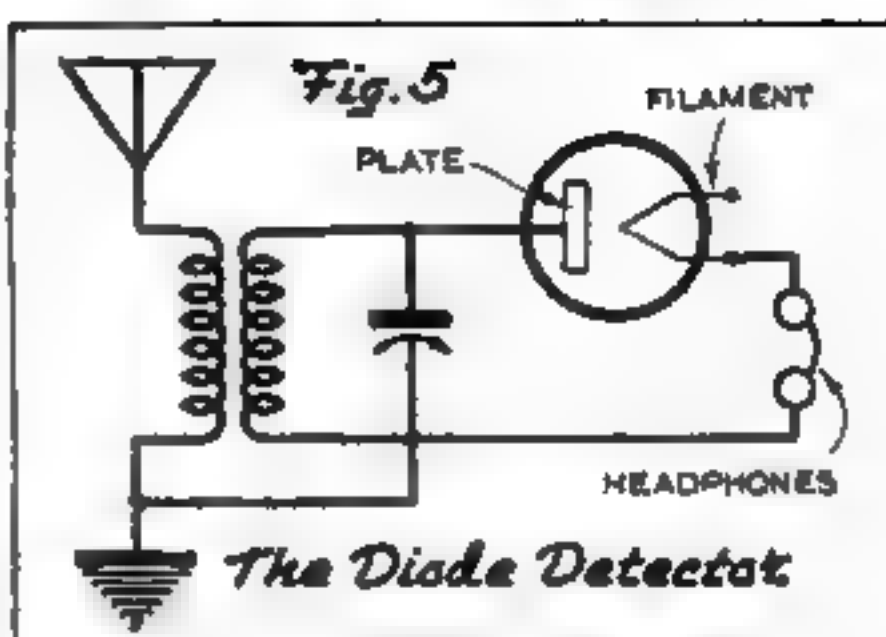


AND HOW THEY WORK

derstood phenomenon in which certain metallic oxides exhibit the ability of rectifying A.C. The plate-and-needle detector, essentially a metal needle resting lightly on a metal plate, embodies this principle, as does the razor-blade radio shown on page 209.

One of the most sensitive instruments known in the early days of wireless was the galvanometer. Unfortunately, it requires direct current; if it is fed A.C. of even moderate frequencies, the needle tries to swing one way on positive impulses and the other way on negative ones, with the result that it stands quite still. Before it could detect R.F., it had to be coupled with a rectifier that would intercept half the R.F. wave.

To improve the detector, the British Marconi Company called in Dr. J. A. Fleming, a leading English research physicist. Flem-



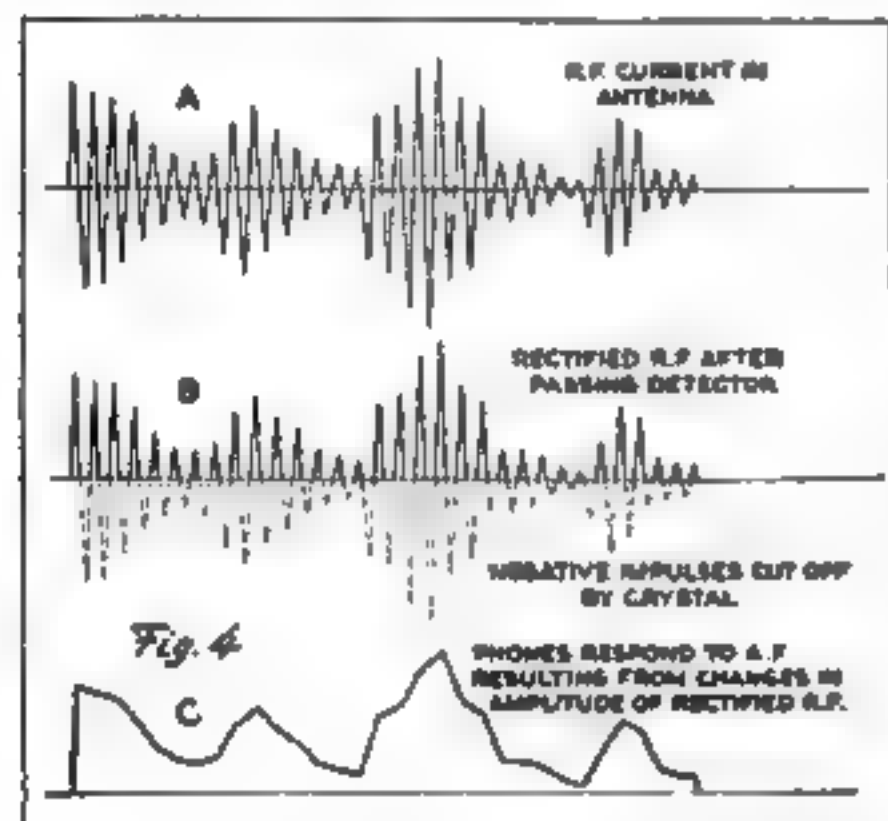
ing had already done some notable research for a lamp-bulb manufacturer. The carbon-filament lamps of the time had a tendency to burn out at the positive end of the filament, due to the "Edison Effect." Edison had reported that a hot filament in an evacuated tube would retain positive but not negative charges—in modern terms, that it would give off electrons. Therefore electrons jumped from the negative end to the positive, carrying part of the current and heating the positive end by bombardment.

Dr. Fleming's studies of the Edison effect, plus his realization that the galvanometer would make a sensitive detector if it could be used with R.F. currents, gave him the answer—the Fleming Valve. It was a simple diode rectifier, a heated filament and a

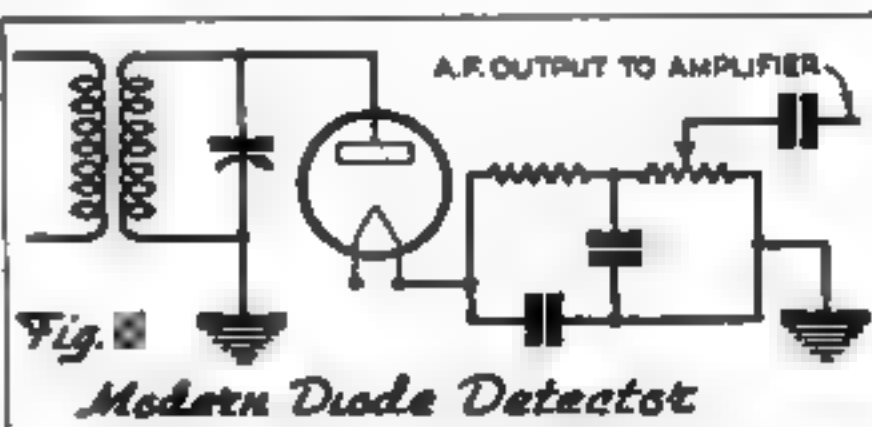
plate in an evacuated envelope, in series with a galvanometer and the antenna circuit. The diode permitted one half of the waves to kick the moving coil, but blocked the opposite set of half-waves. Before long headphones, taken over from the telephone, were used in place of the galvanometer and found unexpectedly efficient (Fig. 5).

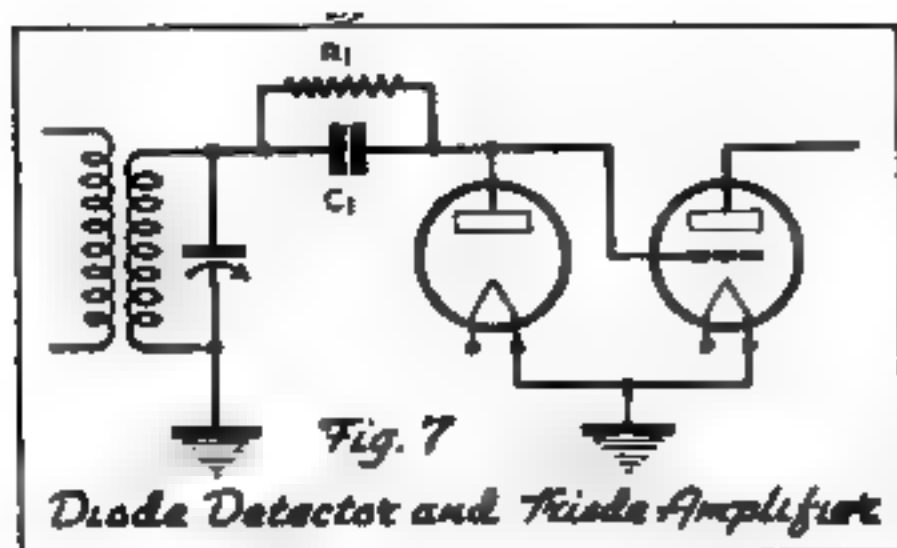
Essentially, a demodulating detector is a nonlinear element—one that will pass more current in one direction than in the other—followed by a filter circuit. (A diode can be made to pass 95 percent of one half-wave and none of the other; a crystal may pass 80 percent of one and 40 percent of the other. So long as conductivity is dissimilar, demodulation will take place.)

In the simple diode detector shown in Fig. 5, the headphones themselves constitute the filter; the phone coils have sufficient inductance and capacitance to make an excellent R.F. trap. In Fig. 6, which shows a more modern version of the diode detector, a resistance-capacitance filter is used instead. The condensers and resistors are of such



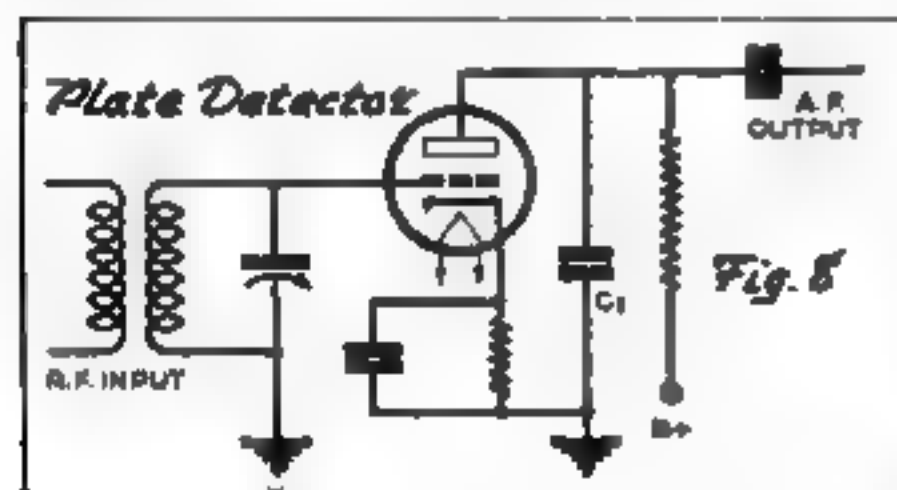
values that the condensers discharge through the resistors only at comparatively low frequencies—15,000 cycles a second or less—with the result that the ultrarapid R.F. pulses are completely smoothed out and only modulation remains. (Turn the page.)





The diode detector is commonly used today. It can handle very strong signals without overloading, has excellent fidelity, and is simple and reliable. However, it isn't extremely sensitive, since the filter system imposes a load that draws power from the tuned circuit. This in turn reduces selectivity.

Fig. 7 shows a modified diode detector directly coupled with a triode amplifier. Here the filter circuit operates somewhat differently; when a positive R.F. signal comes along, the 250-mmf. condenser C_1 transmits it freely, applying a positive potential to the diode plate and drawing electrons from the filament until the charge on the condenser is neutralized. This may take less than a ten-thousandth of a microsecond. When the positive peak declines to zero, the electrons are trapped on one plate of the condenser, on the plate of the diode, and on the triode grid. Their only escape is through the high-



resistance shunt, and it takes more nearly ten thousand microseconds than a ten thousandth of a microsecond for the charge to leak away. Thus the charge on the condenser can increase at radio frequencies but can decrease only at audio frequencies. Since it is applied directly to the triode grid, the triode plate current will follow A.F. modulation.

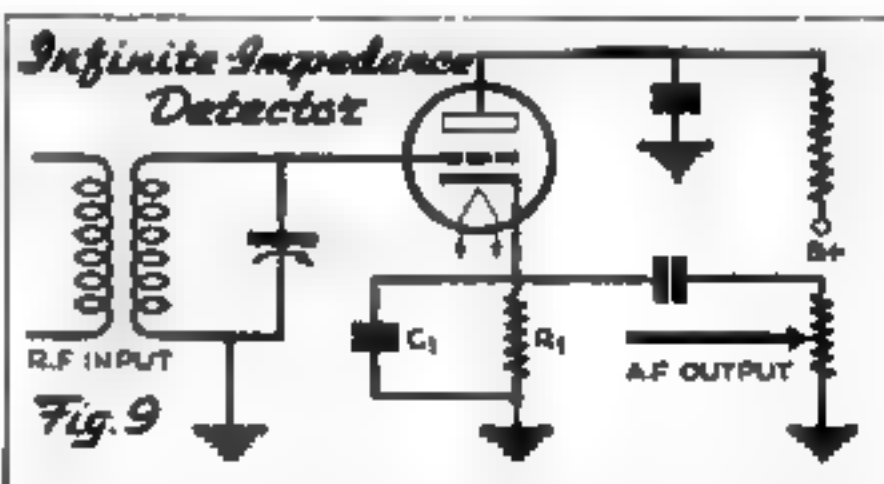
The grid of a triode is quite capable of collecting electrons from the filament, and consequently can serve as a diode plate in itself. In the grid-leak detector of years past, a single triode was used to perform this double function. The grid-leak detector was

selective, though the fidelity was not high and it tended to overload on strong signals. It is seldom used today.

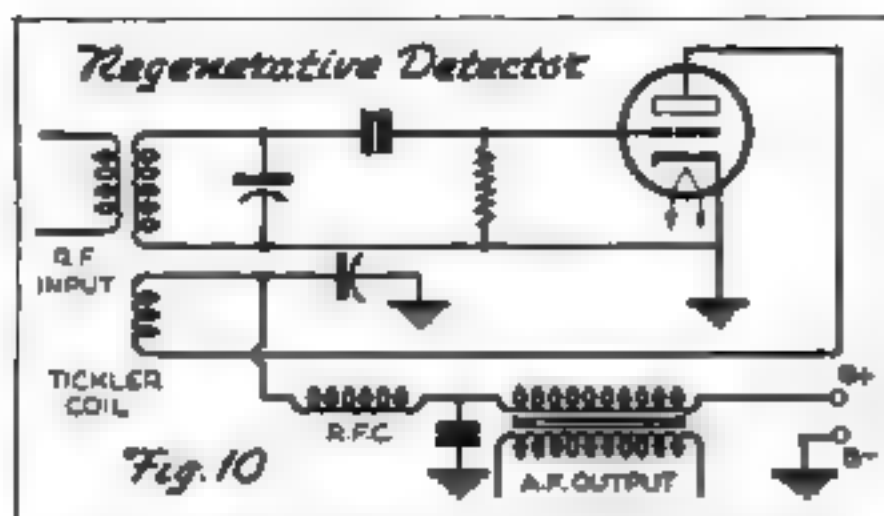
The circuit of a plate detector is shown in Fig. 8. The high value of the cathode resistance makes the grounded grid strongly negative with respect to the cathode, so much so as to cut off the plate current when there is no signal. When a negative signal reaches the grid, practically no change of plate current occurs, for it's already nearly zero. But when a positive signal arrives, the strong bias is decreased and plate current flows. This gives the nonlinear reaction necessary for demodulation. Condenser C_1 shunts the R.F. pulses to the ground. Able to handle fairly heavy signals, the plate detector shown gives good fidelity. It imposes no load on the tuned circuit and hence has good selectivity.

The infinite-impedance detector, so called because it has almost infinite resistance to R.F. between grid and ground, and hence places no load on the tuned circuit, is illustrated in Fig. 9. A positive signal applied to the grid permits the plate current to flow, and this causes a voltage drop through R_1 that drives the cathode positive. Since there is always some current flowing through the tube, the cathode is always somewhat positive with respect to the grid, and no grid current flows. Whatever the positive potential of the grid, the cathode will rise to match it, though it won't follow the negative swings as rapidly because of C_1 . The result is that the potential across R_1 exactly follows the peaks of the R.F. signal. There is no amplification, but the detector has excellent fidelity, will handle strong signals, and is much used today.

Fig. 10 is the regenerative detector, of evil memory. It has excellent sensitivity and selectivity, but against these are poor fidelity, extreme unreliability, complexity of operation, and a bad tendency to turn into



a transmitter able to send out squeals and howls into neighboring counties. Outlawed on broadcast frequencies now, it is still used by some amateurs on short-wave receivers. Basically it is a grid-leak detector so ar-

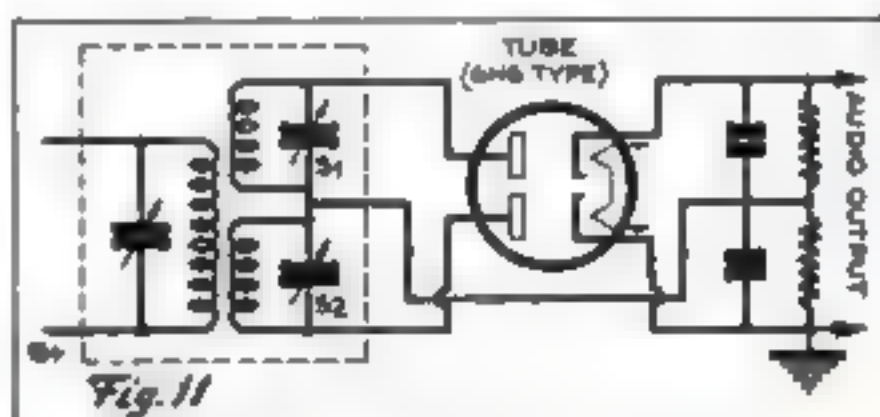


ranged that part of the amplified signal is fed back to the grid to be reamplified. The feedback is supposed to be just a little too weak to sustain self-excited oscillation, the trick being to adjust the feedback just right.

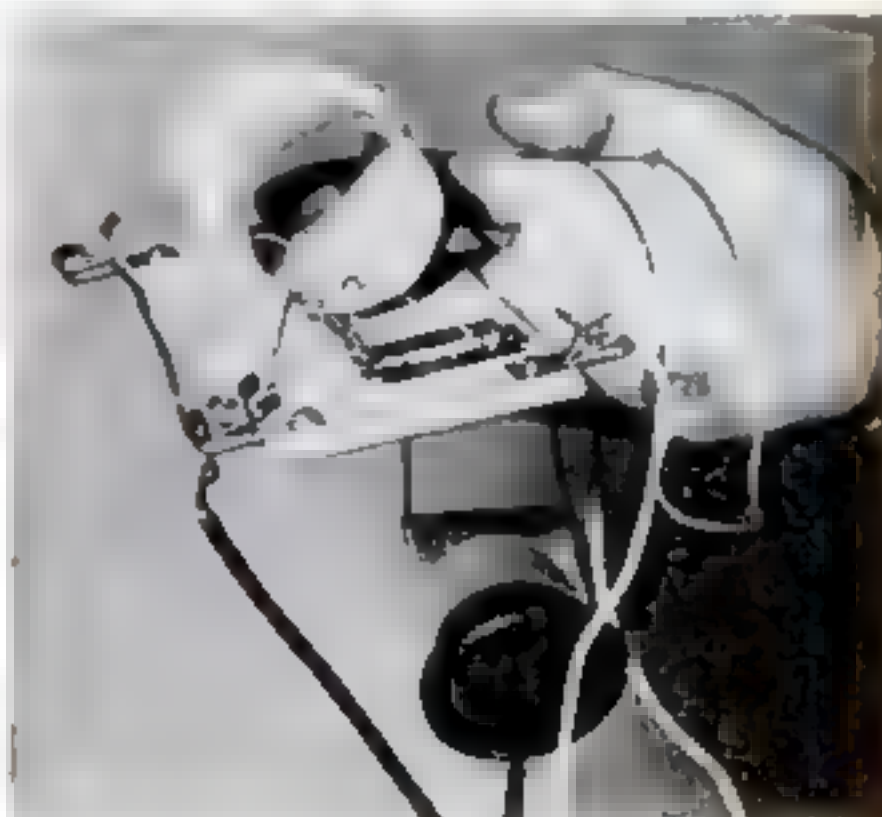
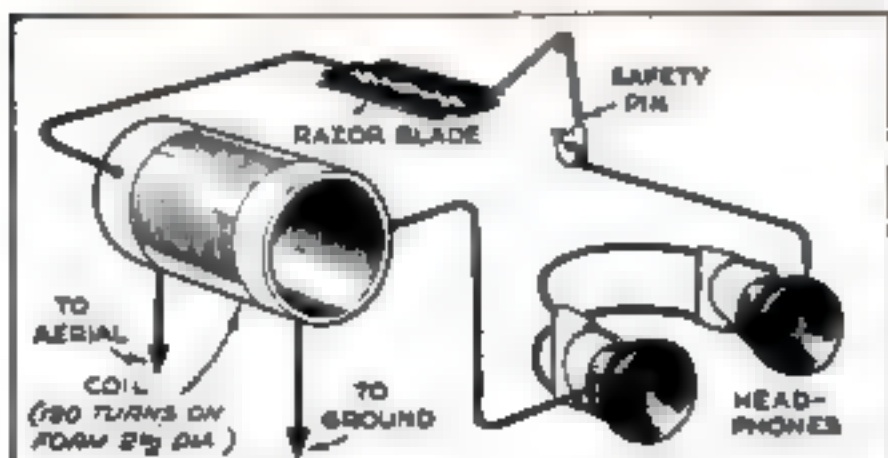
A modification of this, the super-regenerative circuit, has several interesting and useful features. Though tricky, it's exceedingly sensitive and sharp-tuning. Essentially it is a regenerative detector, but a "quench circuit" consisting of a triode and an inductance-resistance network acts to interrupt its functioning at a supersonic frequency. The theory of its operation is ingenious. An ordinary regenerative detector with a little too much feedback will hesitate for a fraction of a second, then gradually sweep into oscillation. The super-regenerative detector has so much feedback as to cause oscillation, but the quench circuit keeps interrupting it before the oscillation can establish itself. This permits a tremendous amount of reamplification. The circuit is particularly useful on frequencies of 100 megacycles and above, where tube losses tend to be severe, for the principle permits B power to replace such losses.

The problem of demodulating F.M. signals is quite different from that with A.M.

In Fig. 11 the R.F. input is fed to a special intermediate-frequency transformer that has two secondary circuits, S_1 and S_2 , each of which drives a conventional diode detector and filter circuit. (Usually one 6H6 dual-diode detector tube is used.) If the intermediate frequency of this receiver is 5.00 megacycles, the primary of the "discriminator transformer" would be tuned to the same value, S_1 tuned to 5.10, and S_2 to 4.90 megacycles. If the signal comes through at 5.00 megacycles, both secondaries and their associated detectors receive an equal voltage; and since the filter circuits are so arranged as to oppose the voltages, they cancel each other and no A.F. is produced. But when the signal frequency varies either up or down, it will approach the resonance of one secondary and move farther away from that of the other. One will get a decreased and the other an increased voltage, and a net voltage will appear across the audio output. Since the voltage across the audio-output terminals will increase as the R.F. signal departs from 5.00 megacycles, audio volume will be determined by the extent of frequency deviation. Audio pitch will likewise be determined by the number of times a second that frequency deviation occurs. The circuit therefore meets the required conditions of F.M. demodulation.



Lt. M. L. Rupert's "foxhole radio," used on the Italian front, gets reception on a razor blade. O. B. Hanson, chief engineer of N.B.C., improved it by tying pencil lead to the pin point. Wire gauge is not critical, but good headphones, a long aerial, and patience in locating a sensitive spot on the razor blade are all requisite



Tin

From the Bronze Age to World War II, this metal has been useful to man.

By

KENNETH M. SWEZEY

WHEN you next speak of tin, be sure it's with respect. For tin is not only one of the most useful of the common base metals, but it is by far also the most expensive. At a price of 52 cents a pound, this erroneously maligned metal is more than three times as costly as aluminum, is four times as dear as copper, and is 40 times as expensive as iron. What's more, its important contribution to everyday living and to industry makes it worth the price.

Tin is one of the most ancient and honorable of metals. Alloyed with copper to make bronze, it has been used to fashion weapons, utensils, and tools since prehistoric time. In this alloy, tin makes the copper harder and more resistant to atmosphere and gives it a lower melting point. The tin mines of Cornwall, England, now supplying tin for the Allies' war effort, have been in almost continuous operation since the Bronze Age.

In normal years, the United States manufactures about 12,000,000,000 "tin" cans—cans of sheet iron or steel coated thinly with tin for protection against the atmosphere and food acids. Millions of iron and steel kitchen utensils are similarly coated. Candy bars, other foods, and a variety of products before the war were protected by thinly rolled sheets of tin foil. Tubes of thicker sheet tin form containers for toothpaste, shaving cream, and medical products.



Tin cans and tinware are made by plating iron and steel. Dip clean sheet iron into molten tin covered with a layer of zinc chloride, and it is quickly tinned. Zinc chloride acts as flux

Solder, babbitt, type metal, pewter, bronze, bell metal, and gun metal are all alloys containing tin. Tin compounds are used in chemical manufacture and analysis and in the processing of textiles.

When the Pacific war cut off most of our supply of tin ore, which had come from the Malay Peninsula and the Dutch East Indies, scrap drives and the disappearance of tin foil and tinware made Americans suddenly aware of the importance of tin.

Perhaps the commonest use of tin is in plate, of which the tin can is the most familiar. In tin plate, the iron and steel keep the cost low and give strength, while the tin provides protection from air, moisture, and weak chemicals and gives the plate its bright surface. A standard method of tinning is simply the dipping of a cleaned sheet of smooth iron or steel first into a flux and then into a pot of molten tin. The coating of tin adhering to the metal sheet when it is withdrawn is thin and uniform.

You can easily demonstrate tin-plating in your home laboratory with the help of a Bunsen burner and a small crucible. Melt

bits of scrap tin foil or toothpaste tubes in the crucible until it is about two-thirds full. As tin melts at 232 deg. C.—the lowest melting point of any of the common metals except mercury—the fusion is simple. After all the tin has been melted, lower the temperature so that the tin is kept just above the melting point, and then add a layer of zinc chloride to a depth of about $\frac{1}{8}$ ". If the temperature of the tin is too high, the zinc compound will vaporize and give off dense, annoying smoke.

Cleanse a small strip of iron or steel by immersing it for a few seconds in dilute acid and rinsing in water. Now, holding one end of the strip with tongs or forceps, dip it slowly into the crucible and withdraw it just as slowly. Rinse and wipe the strip, and you will find the end coated with a bright plating of tin.

That tin cans are mostly iron can be proved by cutting out a small piece, putting it in a tumbler or beaker, and pouring over it a few milliliters of concentrated nitric acid. After the metal has dissolved completely, fill the glass with water to dilute the acid and the metallic salt it contains.

The yellowish-brown color of this diluted solution is one clue that it contains iron, but you can get definite proof by adding a few drops of potassium thiocyanate solution, which will turn bright red, indicating the

presence of iron in the piece of "tin can."

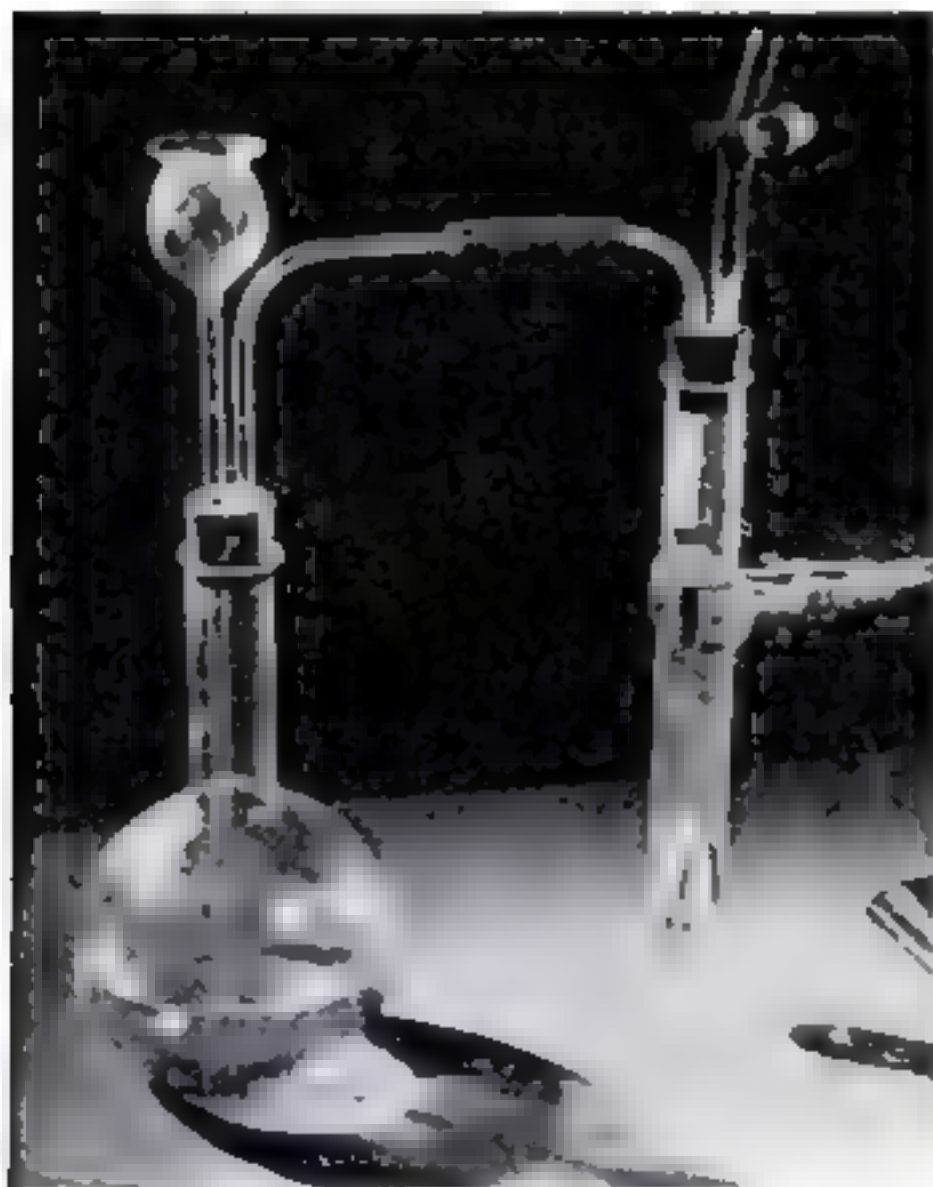
If you have apparatus sensitive enough to detect the exact quantities of metals in a tin can, you will find that it contains at least 98½ percent iron and less than 1½ percent tin. When tin cans rust, it is because the surface tin has become broken, exposing the iron beneath to attack from oxygen.

Tin foil and toothpaste tubes that have been rinsed clean are a good source of tin for home experiments. By improved methods of plating, effective scrap recovery, and reopened sources of tin supply, the Government has caught up on its wartime tin needs, so these materials are not as critical as they have been. Remember, however, that all foil and tubes are by no means tin. Both products are now made of pure tin, a tin-and-lead alloy, lead, and aluminum. For food and cosmetic packaging, the material is generally pure tin or aluminum. If you can't distinguish between these two metals by weight or appearance, hold a piece of foil or tube in the flame of a match. Tin foil will melt readily, while aluminum, with a much higher melting point, will not.

One method of salvaging tin is to treat old cans with dry chlorine gas, which unites directly with the tin, producing a heavy liquid that drips off. This is stannic chloride, a chemical used extensively in processing

To salvage tin, put a strip cut from an old can into a test tube and pass chlorine gas over it. Drops of tin chloride collect inside the tube

Dissolve a scrap of can in nitric acid, dilute this solution, and add potassium thiocyanate. The red color proves that the can contained iron





Soak a piece of unsized cloth in a solution of stannic chloride, and dip it next into household ammonia, as at left, precipitating stannic acid on the fibers; then after it dries, apply a match, as above. Stannic oxide, formed on drying, keeps it from burning

textiles. It can be decomposed into tin and chlorine if these materials are more desired.

You can demonstrate this interesting reaction by means of the simple apparatus shown in one of the photos on page 211. Chlorine is generated in the flask at the left in the photo by adding a little hydrochloric acid through the thistle tube to chlorinated lime mixed with water. Gas passes through the connecting tube into the test tube, which contains a cleaned, bent strip of tin cut from a can. The pinchcock on the rubber outlet tube leading from the test tube is left open until the test tube is filled with chlorine, and then it is closed.

In commercial practice, chlorine is carefully dried before contact with the scrap tin plate because even slight moisture would rapidly corrode the iron of the cans. For our experiment, however, this is not necessary. The change that takes place is clearly visible. After short contact with the chlorine, the tin noticeably darkens, and

after longer exposure, it disappears completely and drops of tin chloride condense on the inside of the test tube.

Strange as it may seem, the combination of the gas, chlorine, with the metal, tin, produces a water-clear liquid that contains no water whatever! In fact, if a little water is mixed with this liquid, it becomes a solid! After the chlorine has completed its reaction with the tin in your test tube, you can test for this stannic chloride by lowering a bit of wet cotton wool into the tube. Stannic chloride unites with the water vapor, producing a cloud of white fumes. In World War I, the reaction of stannic chloride with the water vapor in the air was the basis of one type of smoke bomb.

Stannous chloride, another important tin compound containing more tin and less chloride than stannic chloride, is made by dissolving tin in hydrochloric acid. You may make it in a test tube by dissolving as much tin as you can in a few milliliters



When stannous chloride is poured into a solution of mercuric chloride, first white mercurous chloride (calomel) is precipitated, as at left, since the tin chloride steals chlorine from mercuric chloride

If more stannous chloride is added, more chlorine deserts the mercury for the tin compound, forming a gray metallic mercury. Stannous chloride becomes stannic chloride



of warm, concentrated hydrochloric acid. To produce it in crystalline form, dilute the resulting solution and pour it into a glass dish to dry. Pure stannous chloride makes a clear solution. If a solution of the crystals is whitish, it is due to insoluble tin oxychloride produced by chemical reaction with the air. It may be cleared up by adding dilute hydrochloric acid drop by drop.

Among other things, stannous chloride is a powerful reducing agent—a chemical capable of robbing compounds of oxygen, chlorine, and other elements. In this capacity it is used in the manufacture of chemicals, dyes, and medicines, and in chemical analysis.

You can test this property visibly with a weak solution of mercuric chloride (*POISON: be careful!*). Pour some dilute solution of stannous chloride slowly into a test tube containing a little of the mercuric chloride solution, shaking the tube as you do so. The white precipitate that forms is mercurous chloride, or calomel.

Continue to add stannous chloride, however, and even the calomel is transformed, the white precipitate changing to a dark-gray suspension of finely divided metallic

mercury. To bring about these two interesting reactions, the stannous chloride first steals one atom of chlorine from the mercuric compound, and then it steals the other. In doing so, it changes itself into stannic chloride, a tin compound containing two additional atoms of chlorine.

The precipitate of metallic mercury formed in this experiment soon settles, and the solution of stannic chloride above it can be used to demonstrate one of the applications of this chemical in the textile industry. Soak a piece of unsized cloth in the solution, and then dip the cloth into a solution of household ammonia for several seconds. The reaction of the ammonia with the stannic chloride precipitates a new compound, stannic acid, on the fibers of the cloth.

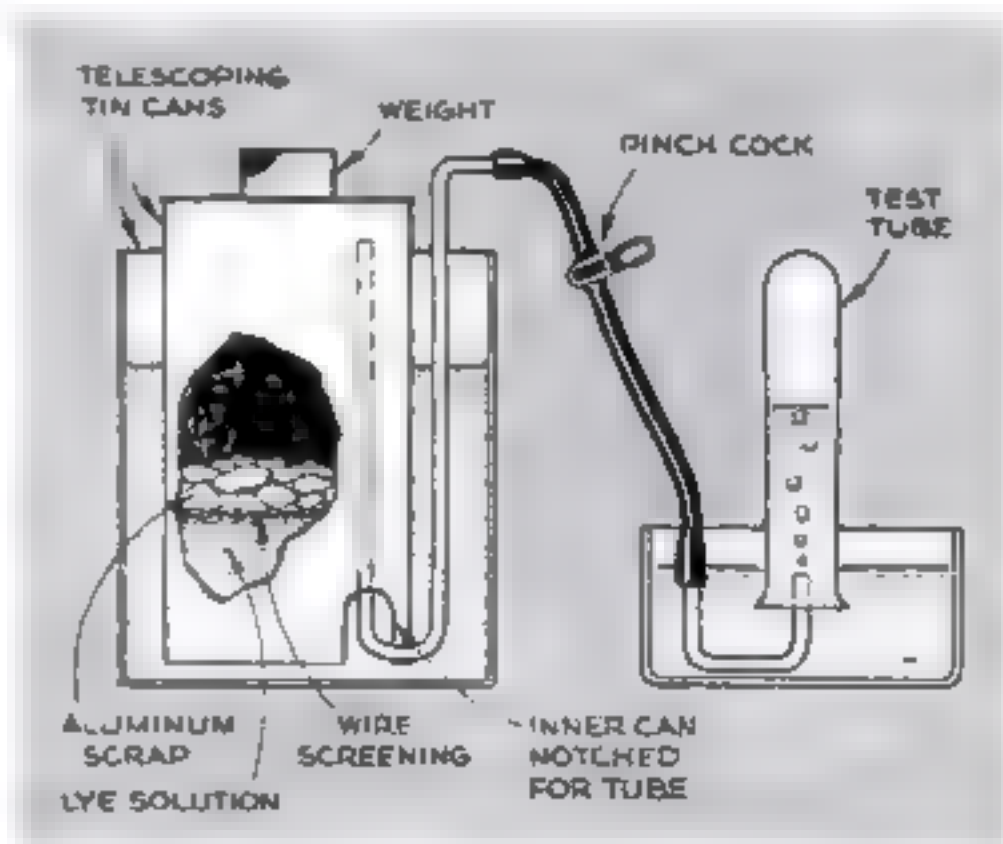
Drying the cloth converts the stannic acid into insoluble stannic oxide, which will not wash out. This oxide acts as a mordant, enabling the cloth to absorb some dyes better than before, and if applied heavily enough, renders the cloth fire resistant. Silk materials are often given different handling qualities, and made as much as three times heavier, by "weighting" them with a tin compound of this nature.

Tin-Can Generator Makes Hydrogen for Laboratory Use

HYDROGEN for your home-laboratory experiments can be generated from bits of an old kitchen pot or other scrap aluminum and common lye in two tin cans set up as shown in the drawing. For this modified Kipp generator have one can small enough to telescope into the other and leave room for pouring in a lye solution. Notch the smaller can, as shown. Make a tightly fitting disk of wire screening, and cut a hole in the screening just large enough to take a bent glass tube. Fit a rubber tube equipped with a pinchcock over the end of the glass tube to lead into the vessel in which the gas is to be collected.

Put aluminum scraps in the smaller can, insert the screening and bent tube, invert this can in the larger one, and hold it down with a weight. Close the pinchcock and pour the lye solution into the larger can until it is nearly full; then release the pinchcock to force out the air,

Be sure all air has escaped before collecting hydrogen in any quantity, for the two combined will explode when ignited. As a test, collect some in a test tube filled with water and inverted in a dish also containing water, and light it with a taper. If the gas pops, air is still present.



HOME EXPERIMENTS WITH



TWO DRINKING STRAWS held at right angles to each other, as shown in the photograph above, will provide you with a simple atomizer with which you can demonstrate clearly the principle on which all atomizers are built. Put one straw in a glass of water

and hold the other so you can blow through it directly across the open top of the first straw. When you blow steadily through the straw you are holding, water in the glass will rise gradually in the vertical straw until it reaches the top. Being met there by the swift flow of air across the top, the water will be broken into tiny droplets and will be hurled into the air as a stream of vapor.

What happens is simple. The pressure at the top of the vertical straw is lowered by the swift-moving current of air passing over it, in accordance with Bernoulli's principle (see P.S.M., Nov.

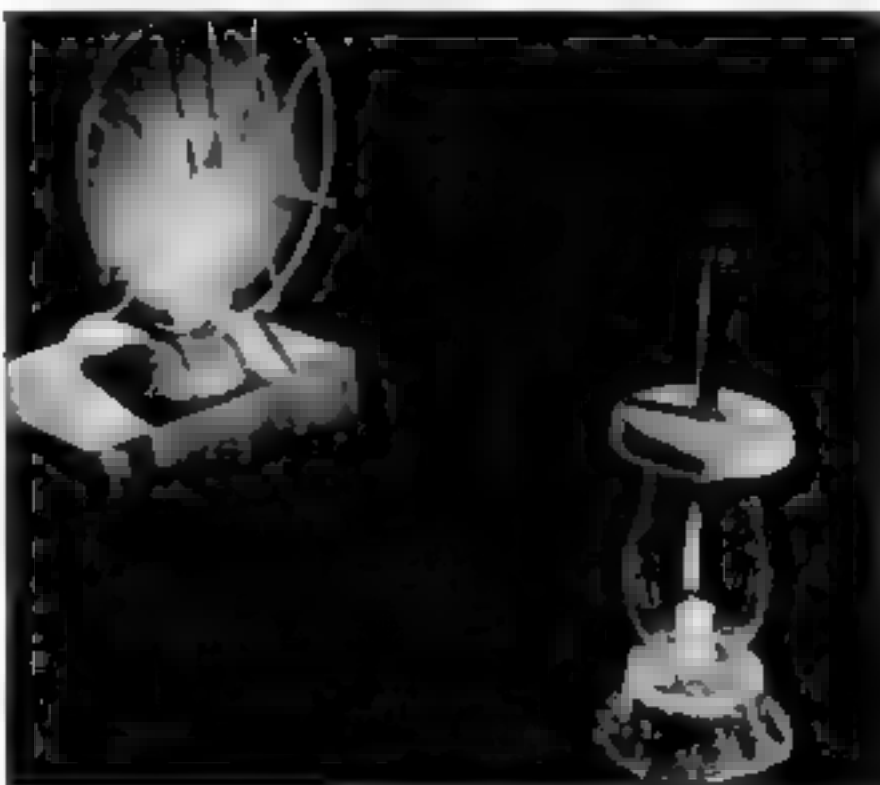
'43, p. HW 584). Thus the air pressure on the surface of the water in the glass becomes relatively greater, and this forces water up through the vertical straw to the top where it is met by the air stream. You can tape the straws to a piece of cardboard.

CHIMNEYS CREATE DRAFT in the same way, illustrating on a giant scale the principle demonstrated with the two straws. For this reason, the fire in the furnace of your basement may draw better when the wind outside is blowing across the open top of your chimney.

You can show this with a setup like that in the photos below. Light a candle in a hurricane lamp or on a base that will admit air at the bottom when a glass chimney is placed over it. Then cap the chimney with

a lid having a hole in which a glass or metal tube has been inserted.

When the air is still about the lamp, the candle will burn with a low flame, but if you blow across the top of the tube, or direct the breeze of an electric fan across it, the flame will leap furiously, as shown in the photo at the right. As with the straws, lowered air pressure at the top produces an unbalance that causes the air at higher pressure below to rush in through the openings in the base and up the chimney.

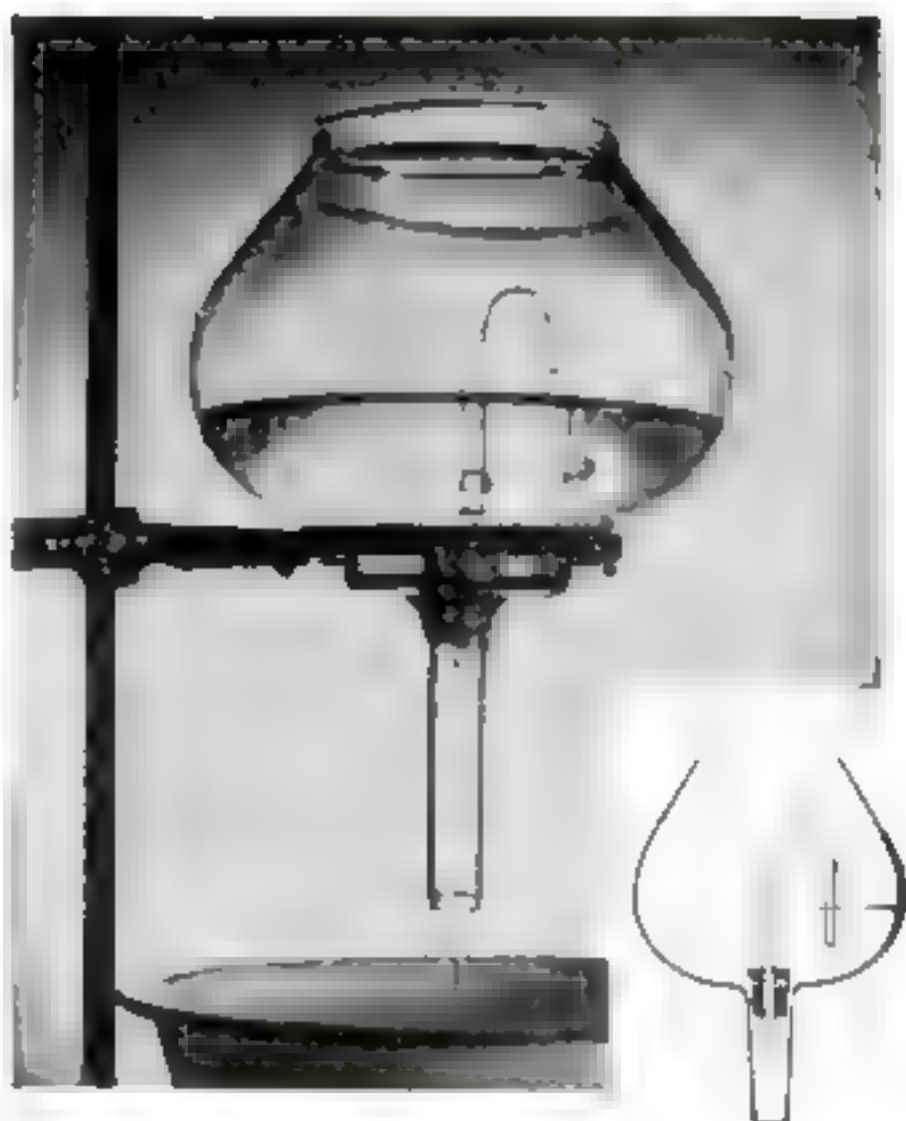
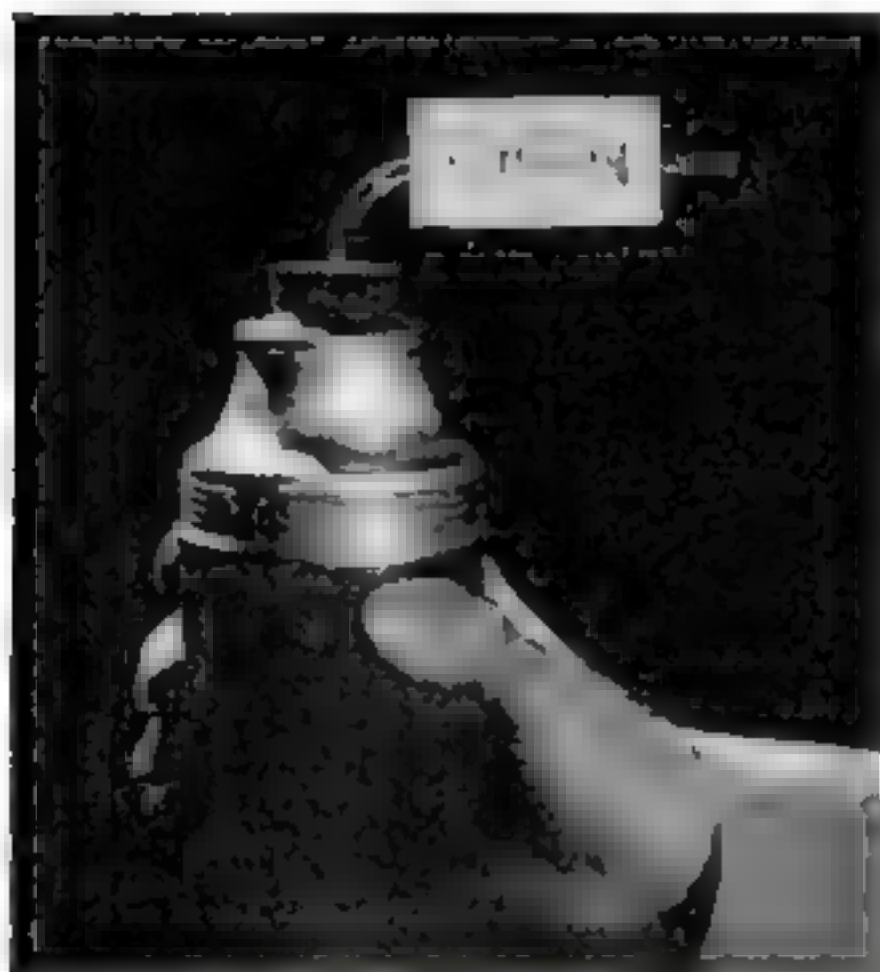


AIR PRESSURE

FOR A SENSITIVE BAROMETER that indicates differences in elevation of only a few feet, fit a vacuum bottle with a holed stopper and bent glass tube, as shown below. Attach a paper reference scale and place a drop of water in the horizontal leg.

The drop remains stationary as long as outside pressure equals that in the bottle. Raise the bottle, however, and the relatively higher pressure inside forces the drop toward the open end of the tube; lower it, and the drop moves the other way.

Use of a vacuum bottle minimizes changes in temperature, while the horizontal bend neutralizes the effect of gravity.



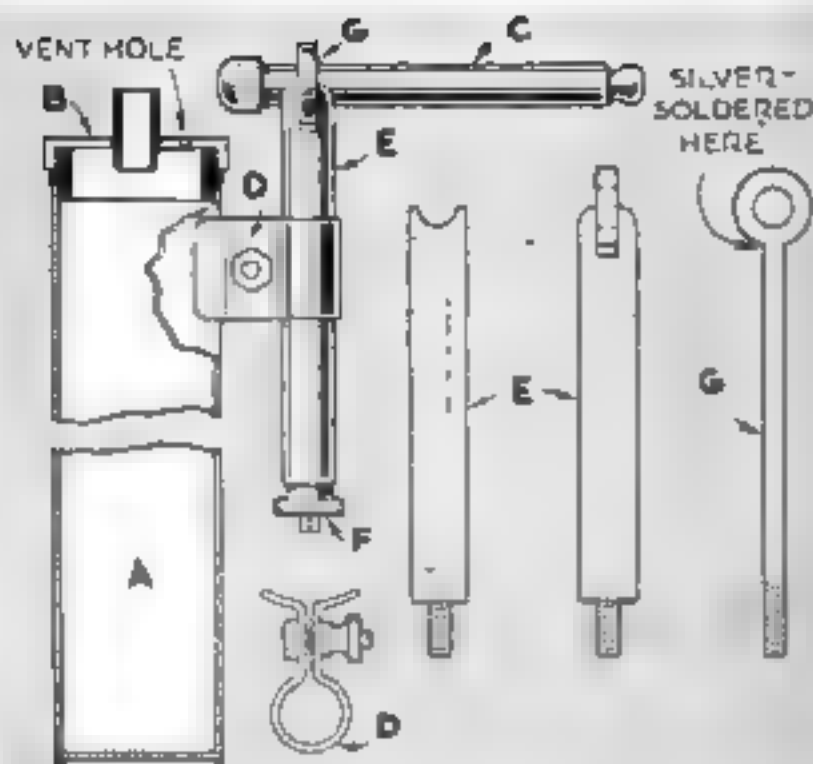
SIPHON ACTION that causes some springs to flow intermittently can be shown with the top of a glass coffee maker and a U-shaped glass tube having unequal legs. Insert the long leg in a cork plugging the coffee outlet and arrange the short leg so it does not quite touch the side.

Now, if you pour water into the bowl, none will run out until the level reaches the top of the inverted U. The flow then continues until the level sinks to the end of the short leg. A changing level in a spring reservoir acts similarly.

TEMPERATURE RISES when air pressure is increased and molecules of air crowd against each other and cause friction. You can demonstrate this with a bicycle or auto-tire valve pushed through a large stopper in the mouth of a milk bottle in which you have placed a thermometer.

Compress the air in the bottle with three or four strokes on a pump—not too many, or the stopper will fly out—and you will see the thermometer register several degrees higher. Release the pressure, and the temperature will fall. Use is made in refrigeration of the cooling effect of compressed and suddenly expanded gases.

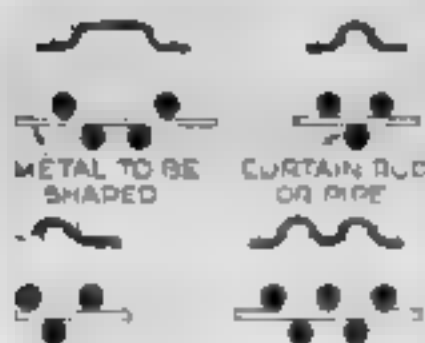




Silver-Soldering Blowpipe

THIS adjustable mouth blowpipe may be made from old or discarded material. Fuel tank *A* is the casing from a tire pump. Top *B* is adapted from a two-piece gasoline-can cover from which the lugs have been removed. Turn the bottom portion of this cover down to fit inside casing *A*. Bevel the lower end of the casing to take a circular bottom piece, put the piece in place, and peen the tubing; then solder the disk. Blowpipe *C* may be taken from an insecticide spray gun. It is held to the tank by a rod-and-ring assembly *G*, tube *E*, and clamp *D*. It should be a sliding fit in part *G*, which is held in place by the knurled spark-plug nut *F*. Tube *E* may be adjusted by loosening the knurled nut on clamp *D*, which is soldered to the fuel tank.—A. DE WET.

Rods Form Fittings from Strips



METAL strips up to 3/32" thick can be bent in a vise with the aid of a few pieces of solid round curtain rod. The above sketches show how to place the metal and the rods in the vise to obtain four different shapes. The pressure of the vise jaws causes the metal to form itself around the rods. For other shapes, alter the positions of the rods.—M. A. JACOBSON.



How's Your Weather Eye?

How well did you do with our weather quiz? Here are the answers to the 10 questions on page 141:

1. **FALSE.** Hair is responsive to humidity and is used in some kinds of hydrometers. When the hairs of the scalp felt alive and springy, the Indians could count on good weather; when the hairs felt soft and lifeless, rain was not far off.

2. **TRUE.** A red rising sun is shining through air filled with particles of dust. These will serve as nuclei for drops of water in the uneven heating of the day.

3. **TRUE.** Fluid rises because of the weight of a mountain of air—a high-pressure area that brings good weather.

4. **TRUE.** Swallows fly low before rain, probably hunting insects made wing-heavy by moisture in the air.

5. **FALSE.** Dew is favored by a cloudless sky with good weather ahead.

6. **TRUE.** Cumulus clouds gathering into large, dark groups usually herald the birth of a cumulo-nimbus, or thunderhead.

7. **FALSE.** Halos are caused by light shining through ice cloudform, usually marking the advance of a warm front—with rain.

8. **FALSE.** Low-pressure areas tend to move toward the east. Only lightning from the west, northwest, and southwest is likely to mean a storm headed for the observer.

9. **TRUE.** Smells held captive by high-pressure air are released and carried abroad when a "low" approaches.

10. **FALSE.** A red sunset is caused by sunlight shining through dry, dusty air—the natural condition at the end of the day when fair weather is ahead.

NOTICE TO SUBSCRIBERS

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Electronic Aids to Better Living *(Continued from page 140)*

frequency induction heating, either electromagnetic or electrostatic.

Induction heating may be applied therapeutically to specific muscles or organs, or to the entire body. In the latter case it is called fever therapy, since in effect an artificial fever is produced. Therapeutic fevers may also be induced by infecting the patient with a fever-producing disease like malaria; this was tried a number of years ago as a cure for syphilis. Even when it works, the disadvantages of such a procedure are obvious. A far better method is to place the patient in a cabinet surrounded by a coil carrying a radio-frequency current produced by a vacuum-tube oscillator with an output of 200-300 watts at a frequency of 25-50 megacycles, or about the same frequency range as is used in industrial dielectric heating. The artificial fever is thus kept completely under control. The patient's temperature may be raised to the desired level without harmful side effects, and as soon as he is removed from the radio-frequency field his temperature returns to normal.

Instead of diffuse application of electronic heat, surgical diathermy utilizes extremely concentrated application of high-frequency currents through a small electrode which functions as an electronic cutting tool and cautery. The electrode produces coagulation as it cuts, so that bleeding is greatly reduced and there is less necessity for tying off blood vessels.

Electric-shock therapy appears to be beneficial in certain psychotic conditions. Electrical anesthesia is another possibility. The amounts of power involved in such applications are relatively large: electric-shock therapy employs temple-to-temple currents of almost half an ampere. The duration of the shocks must be controlled to a fraction of a second, and here again electronic methods are the obvious solution.

It is not to be expected that electronics will revolutionize the practice of medicine; it is, after all, only one physical tool among many. But we can be confident that electronics will play a role of rapidly increasing importance. We may even hope to see, after the present conflict is over, such developments as the great work of G. W. Crile on surgical shock, which followed the last war—work which, like electronic medical methods, was based on the scientific application of physics to physiology.

The conditions under which people work, eat, sleep, and amuse themselves influence their well-being as much as inherited or

acquired factors. Consequently, in discussing electronics in relation to public health, we are interested not only in specific medical applications, but in anything that promises to make daily living more hygienic, efficient, and comfortable. We want to know what electronics can do for us in the office, the factory, and particularly the home.

To get the right perspective, we must distinguish at the outset between gadgets or technological toys, and things which have a serious function. Electronic experts who write, as distinguished from electronic engineers who have to make electronics work and electronic businessmen who have to sell it, delight in getting up long lists of what electronics will do after the war. They usually compile these lists by itemizing everything that electronics can do. But that is a different thing from what electronics will do. The latter depends on the answers to such questions as: How much do we need and want these things? Who wants and needs them, and how many people are included under the *who*? Will they be able and willing to pay for them? A burglar-proofing device for country homes, for instance, may be needed by movie stars and millionaires, but it certainly is not a mass-production article even if all other possible outlets, such as industrial plants, safe-deposit vaults, and museums are included.

Or take electronic cooking. An electronic range, applying the technique of industrial induction heating to chops and steaks, would be a nice thing to have in the kitchen. Such a device would cook the steak quickly and evenly, and it would not be necessary to make an incision to see how well it was done on the inside. The steak would be cooked and not the housewife, for practically all the heat would be concentrated where it was needed. Yet we are not likely to have electronic ranges in our kitchen in the decade following the war, because of some obvious and obstinate facts which have to be considered.

For one thing, it just won't be economic to put the equivalent of a fair-sized radio transmitter in Joe Doakes' kitchen. Joe won't have the money, and if he had it he would be well advised to spend it on something more urgent. As we saw in last month's article, electronic heating is inherently expensive. Electric power isn't too cheap to begin with; then you must convert it to high frequency, losing a considerable part of it. By that time it can't compete

with fuel on a cost basis. That seems to knock out the electronic kitchen for the time being, even without taking into consideration the dangers of high-voltage shock and radio interference which it would necessarily entail.

There is a better chance for electronically dehydrated foods for some special purposes, as when it is desirable to take practically all the moisture out of vegetables so that they will keep a year or two in a tropical climate. A process already in use drives out 80 percent of the moisture with hot air. Then the vegetables are compressed into bricks, electronically heated so that only one percent of the original moisture remains, and wrapped. One kwh. will remove about one pound of water. For use, the dried vegetables are soaked in water and cooked in the usual way. The reason this might work out economically after the war is that only a part of the process is electronic, and that part is carried out after compression and under factory conditions. That makes quite a difference.

A precipitron or electronic air cleaner for every home and office would be a fine thing. This device is in use and perfectly practical; it removes dust, dirt, ashes, and pollen grains from the air by electrostatic attraction. It would probably improve everybody's health to some extent, and would certainly be a boon to hay-fever sufferers and others sensitive to airborne particles. It also makes sense from an efficiency standpoint: why let in dirt and then sweep it around or suck it up in a vacuum cleaner? The thing to do is to keep it out in the first place.

But note that windows would have to be kept closed and be more nearly airtight than most existing windows. Then the air would necessarily be sucked in with a pump and distributed around the house through ducts. In short, you end up with more or less the equivalent of an air-conditioning system. It is idle to talk of mass air-conditioning when many of our existing homes don't even have electricity or inside toilets. So there is not going to be a little precipitron in every American household right after the war.

Fluorescent lighting is an example of an electronic device which, without revolutionary economic advances, will continue to find an expanding market. Basically, gaseous-discharge lighting is old: the names of Faraday, Crookes, and Geissler occur in connection with it as well as the more recent Cooper-Hewitt, Moore, Claude, and others. A high-voltage discharge through gas will produce light at various frequencies, and the amount of useful light may be increased, in any desired color, by incorporat-

ing a hot cathode and chemical compounds known as phosphors which are capable of reradiating ultraviolet light as visible light. Fluorescent lighting is practical, decorative, efficient, cool, and easy on the eyes. In this field, electronics will make a substantial contribution to health and comfort; the process is already well under way.

Generally speaking, however, the impact of electronics on daily living, aside from its indirect contributions through audio and video broadcasting, is not going to be very great in the postwar period. Later? Well, given enough time and an unbridled imagination, one can conceive of an electronic house, almost perfectly insulated and electronically heated or cooled to the desired temperature. Although there are no windows, the occupants can see in every direction by means of suitable television pickup devices in the walls, while no one can look in except over a television telephone line or radio circuit that can be switched on or off at will. Radio brings every form of entertainment and instruction from near and far. The electronic house offers the combination of perfect privacy and perfect communication. About the only tangible contacts with the outside world it will need are an intake for electronically purified air, a door or hatch for the delivery of electronically cooked food, and, if the occupants are socially inclined, for the entrance and exit of electronically sterilized visitors. But, since the visitors can be heard and seen, and perhaps even smelled and touched through future electronic inventions, they might just as well stay home and use electronic channels for social intercourse.

Personally I am too reactionary to envisage this way of life with any pleasure. But there is no need to be alarmed; it will scarcely come before the 21st century. Before that time, electronics may give us the large-scale transformation of mass into energy, so that a battleship will be driven across the ocean with a few ounces of fuel. Or, as Dr. Irving Langmuir has suggested, airplanes may plunge at speeds of 2,000 to 5,000 miles an hour through vacuum tubes extending from New York to San Francisco. These highly speculative possibilities are beyond the scope of these articles, which have dealt only with short-term probabilities. We can be sure that electronics will make possible better communications, safer travel, entertainment limited only by our creative abilities and tastes, all sorts of useful industrial devices, and medical techniques capable of prolonging and enhancing life. If the really revolutionary electronic inventions are delayed until we have learned to use these immediate gifts wisely, it may be just as well.



"When Day's Work Is Done" painted by Rudolf Wettlaufer

Home

Peace. Privacy. Your own domain, where you are "boss." Where you can do as you please, when you please and how you please.

It won't be long now—that's what we're working for.

And when the work is done, there are plenty of things you'll find unchanged at home—one of them is Kaywoodie, the pipe most men have adopted as the best in the world. It'll be the same mild, cool, flavorful smoke, made of the same fine Mediterranean briar, as before the war, or long ago.

Many Kaywoodies go direct to our fighting men—please be patient if your dealer temporarily can't supply you. Illustrated here is Flame Grain Kaywoodie "Billiard" Shape No. 515 \$10.00.

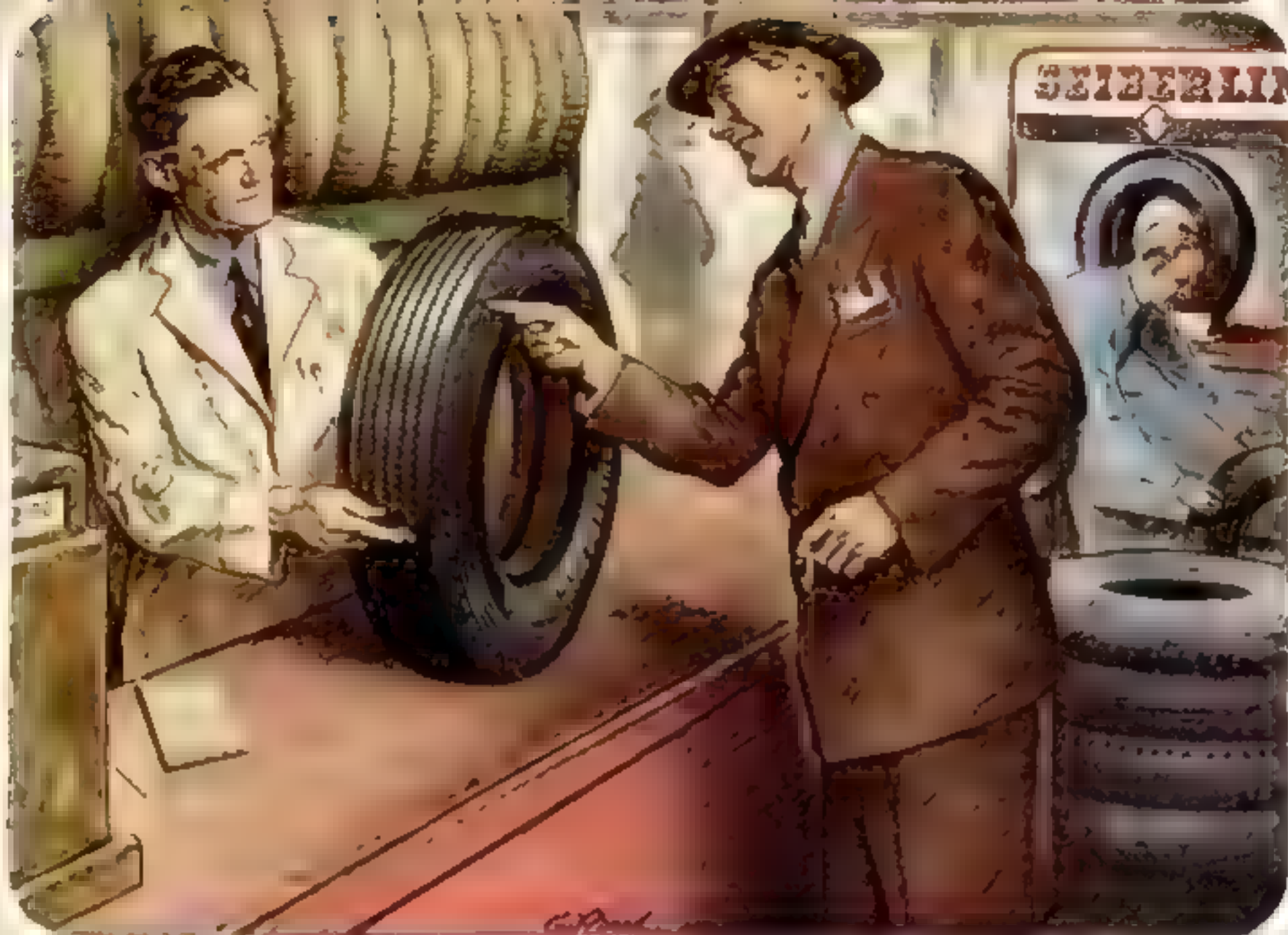
Kaywoodie briar is a natural product. Time, and the sun and soil and wind produce it, and they're not in a hurry. Our seasoning of it isn't hurried, either. It takes years to make a Kaywoodie.

These stout pipes are tempered with special curing-agents, so that they transform tobacco into the most delicious, fragrant, satisfactory smoke you ever tasted. We promise you thoroughly agreeable enjoyment, and we believe you'll find Kaywoodie-smoking one of the best, most satisfactory experiences in life.

**War Bonds
come first**



Kaywoodie Company New York and London
630 Fifth Avenue, New York 20, N. Y.



Remember when . . .

You could buy a pre-war tire like this?

It was made of natural rubber by top-flight Seiberling craftsmen. It was good to look at, and good to ride on because it delivered many an extra mile of safe, comfortable driving-per-dollar. Both those who rode on it and those who sold it recognized it as America's FINEST Tire.

AND NOW AGAIN

in the new Seiberling Tire made from *synthetic* rubber . . . you get that "something extra" you've learned to expect from Seiberling. Rich experience, engineering skill and manufacturing craftsmanship have transformed wartime synthetic rubber into handsome, durable Seiberling Tires. They are the latest achievement of "Experts in Rubber" devoted to building the *best*.

And when you get your new Seiberling Synthetic Tires, you get still another "best." You get a personal, "interested in you" service that's extra valuable now. Your Seiberling Dealer is an *Independent Dealer*—a self-reliant man who has had the initiative to build his own business

—the kind of man who has helped create freedom and opportunity in America. He has the strongest of all incentives to serve you well . . . his success and his future depend upon it.

Although tires are more plentiful than they have been for a long, long time, please remember this: We still cannot risk creating another severe tire shortage through abusing the tires we have. This is especially important now because synthetic rubber is a new material that requires extra care. Don't drive your synthetic tires either under or over inflated, and be sure to have small cuts and bruises repaired promptly. There's where your Seiberling Dealer can help you. He is an "Expert in Rubber."

SEIBERLING *Experts in Rubber*



Wartime manufacturers of Bullet-Sealed Tubes and Military Tires for our armed forces • Bullet-Sealing Gasoline Tanks • Rubber Floats • Boats and Pontons • Rubber Parts for Gas Masks, Airplanes and Tanks. Also makers of Tires and Tubes for passenger cars and trucks • Sealed Air Tubes • Rubber Heels, Soles and Mechanical Goods.

Pattern for Pacific Victory

(Continued from page 71)

That posed the question in the enemy's mind as to where the major blow was to fall. He did not dare move reinforcements from the southern tip of Bougainville into the Empress Augusta Bay area. Reserves had to stand by until the question was answered.

When the landing was made this is what happened:

Fighters strafed the beachhead and provided cover against enemy air attacks. Bombers plastered the area immediately behind the beachhead. Submarines patrolled the adjacent waters to screen the operation from any ships that the Japs might send down from Rabaul. A cruiser task force shelled Buka airfield, just off the northern tip of Bougainville. Then it stood out to sea to intercept any enemy naval units that might race down from Rabaul.

Destroyer fire supported the landing proper by barge transports and cargo ships that pushed close inshore. Those were the only types of amphibious-warfare landing craft that we had at the time.

Jap airmen flew 200 sorties against us, but it was too little and too late. A dozen Jap ships sailed down from Rabaul to contest the landing. They limped home.

Other actions were concurrent with the march up the Solomons. Two weeks after the Russell Islands were occupied, in February 1943, the Army broke the back of the Jap supply line to New Guinea in the Battle of the Bismarck sea.

While New Georgia and its Munda Point airfield were being occupied, Woodlark and Kiriwina islands, off the northeast coast of New Guinea, were seized for airfields. Allied troops landed at night at Nassau Bay, 10 miles south of the Jap base at Salamaua, and began fighting up the coast.

The map of the Pacific shows how Australian and American forces, perforating the northern New Guinea coast in leapfrog operations for more than a year, carried their campaign right into the alleyway behind the Philippines to support and participate in our return to those islands.

Domination of the air, so vital to successful leapfrogging, depended in the Solomons both on carriers and on the seizure of fields that would permit land-based fighters to escort bombers on forays preliminary to a new landing. Now another problem came up. If the pace of the advance over the Pacific was to be accelerated, longer jumps were imperative.

The Navy had the answer: more carriers—more carriers, in fact, for a single task force, than the Japs could muster in their

entire navy. It was with the aid of carrier-borne air power that we smashed into the Gilberts last November and prepared for the next step: the investment of the Jap arsenal of the Marshalls.

Gradually the water-borne equipment for amphibious operations was being accumulated. In February, when we went into Roi, Namur, and Kwajalein—leapfrogging the heavily defended eastern chain of atolls where the Japs expected us—we had the storehouse of a Midas in battleships, carriers, cruisers, destroyers, transports, and landing craft.

From this point on, the Allies donned seven-league boots. Truk, struck by a roving task force in mid-February—even while we were investing Eniwetok atoll to obtain a front-row land bombing base for use against that storied, formidable fortress—was as good as dead when the Japs lost the Marshalls. So was Rabaul. So was what remained of Jap resistance in New Guinea. So was the whole, fearsome Caroline archipelago.

Leapfrogging had done them in.

Allied submarines and airplanes immobilized them as certainly as though they were caught in a web of steel. We by-passed such fortified points as Ponape and Kusaie—easternmost of the Carolines—and then began eroding them with bombs and starving them by torpedoing their supply ships.

It was only a step to the Marianas—to Saipan, Tinian, Rota, and Guam—and beyond for the Allies' amphibious forces. This one fell swoop neutralized the Bonin and Volcano islands, closer to Japan than Bermuda is to New York. The Japs, drunk from their own preachments of invincibility, confident that their eastern sea defense line was impregnable, had just begun to build some new airfields on Saipan, a Japanese mandate for a quarter of a century.

The Marianas and New Guinea became twin prongs pointing straight at the Philippines.

Leapfrogging has established the pattern of Pacific victory. We shall not attempt now to reduce the vast archipelago of the Philippines, with its 7,000 islands. It would be too costly. It would take too long. We shall neutralize the Philippines from our meticulously selected bases and leave the Japs to the care of the reborn Philippine Constabulary.

The isolation of the Philippines will lay open the China coast to an Allied invasion. It will be the beginning of the end for the Japanese dream of empire.

Robot Mathematician

(Continued from page 89)

and chemistry may be solved more rapidly. Calculations that it will make possible may also promote progress in the social sciences, changing our daily lives.

Professor Aiken, indeed, may find it difficult to decide which of the many problems that will be presented to him should be dealt with first. He admits that he cannot compute his own income tax without help. But he would not think of permitting his figure factory to be used for such comparatively simple work. There is no dollar sign on this machine.

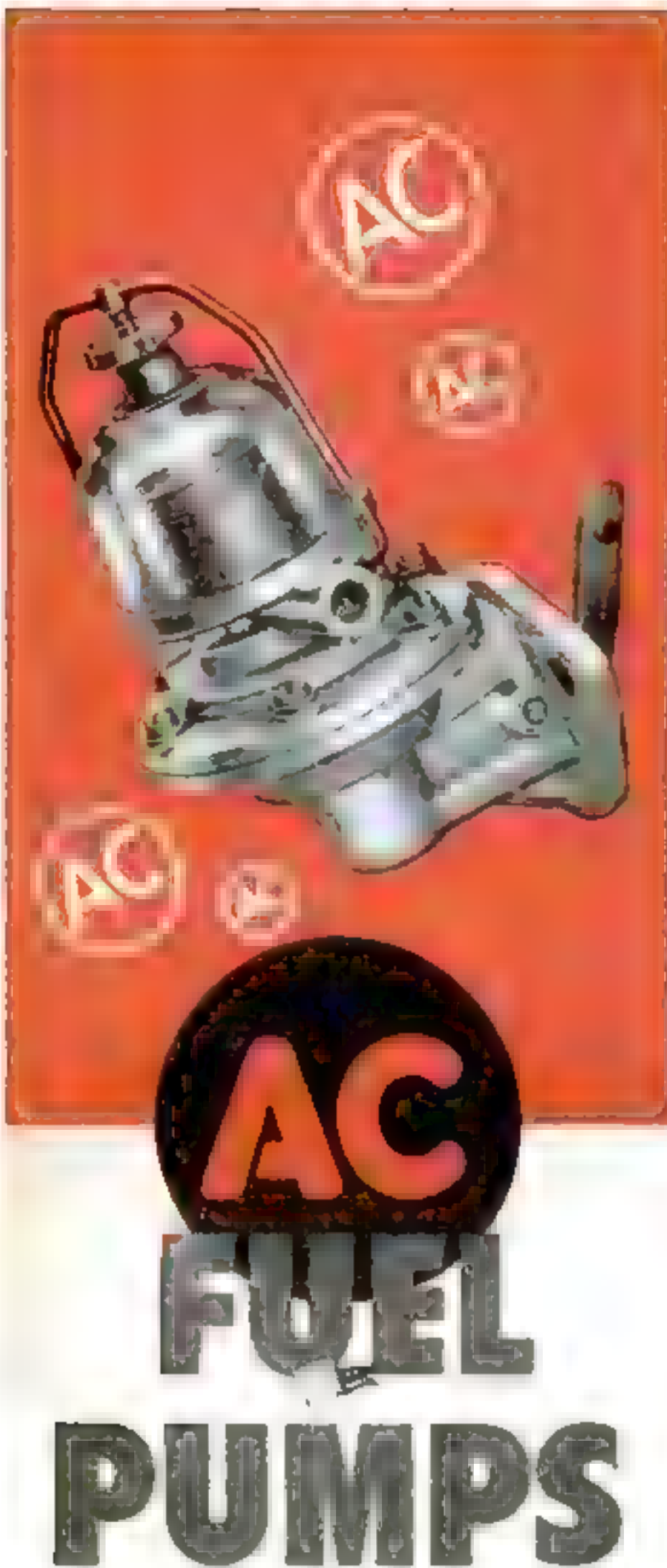
There are a half dozen other great mathematical machines in the world, but none of them is as versatile as this one. Some do valid mathematical tricks with cards; others resemble big and very accurate graphs and slide rules. Problems that can be solved as well or better by those machines will be left to them. This Paul Bunyan will stride through forests of figures that might not otherwise be explored for centuries—if they were ever explored at all.

Commander Aiken modestly ascribes the conception of this device to his own laziness. He is a tall, blond, 42-year-old electrician and scholar. To finish high school, he had to take correspondence courses while employed nights by an Indianapolis power company as a switchboard attendant. This accounts for the construction of the calculator in the form of a switchboard. To complete his thesis for a doctor's degree at Harvard, he had to make calculations that took him nearly a year. This accounts for his decision to see whether such a machine could not be built.

For two years, he did not mention his breath-taking idea to anyone. He had to convince himself first that it was feasible. Then, in 20 minutes, he interested an International Business Machines Corporation engineer in the idea. Clair D. Lake, a pioneer inventor of mechanisms for I.B.M., was put in charge of work on the plans. Three other I.B.M. experts, Frank E. Hamilton, Benjamin M. Durfee, and James W. Bryce, also became coinventors. It took the company six years and cost more than \$250,000 to build the machine. I.B.M. then presented it to Harvard.

This calculator is a generalized or algebraic machine. It does not rely on measurements, but works directly with numbers. Although called a super-brain, it does not really think. It merely obeys a mathematician's orders, and if he errs, the results are wrong. It enables him, however, to

(Continued on page 226)



You have enjoyed such good service and long life from your AC Fuel Pump because of the quality that is built in, from design to finished pump.

You will continue that performance and quality if you insist on an AC when you need a new, or a rebuilt, fuel pump.

BUY WAR BONDS • BRING VICTORY QUICKER

THREE STORIES ABOUT THE BAZOOKA

Invasion Story

★ A German fort was causing considerable trouble to an American landing party. One soldier detached himself from the party, and waded ashore with a Bazooka. With one shot he knocked out the fort, and the Germans surrendered. —From a report from the European theatre

Jungle Story

★ A Yank on patrol suddenly came upon two Japanese tanks. He slipped behind a tree, and let go at the nearest tank. The first rocket from his Bazooka blew up the tank, and its exploding ammunition set off the second tank. Score, two tanks with one shot! —From a report from the South Pacific



Home Front Story

★ Back of the action stories of the Bazooka on the fighting front is an action-packed home front story of how the Bazooka was built.

On May 21, 1942, a U. S. Army pursuit ship slipped into an airport near a G-E plant. It carried an Army Ordnance officer, and instructions for General Electric to design and produce within thirty days several thousand rocket guns—an assignment so important that it took precedence over all other ordnance in the country.

Twenty-four hours later a G-E engineer came up with the design.

Four days later the first gun was turned out.

Then came the tests, at Aberdeen. For more than two weeks the Bazooka was tested and developed and improved until it had proved itself as a first class fighting weapon. Two men could handle it easily—one in an emergency—yet the Bazooka fired a projectile that could knock out a tank.

All that remained was to produce the quota, several thousand Bazookas, within the remaining eight days!

G-E men and women did it. Parts were rushed by plane and taxicab. Men and women worked through their lunch hours, and stayed over to help the next shift. And seven days after production started, while the first Bazookas produced had already been rushed into action on the Russian and North African fronts, the quota was made, with eighty-nine minutes to spare!

Since then General Electric has turned out hundreds of thousands of Bazookas, but the story of how the first several thousand were produced remains a tribute to G-E workmen, and another example of how G-E engineering and manufacturing experience work to meet America's needs—in war, and peace. *General Electric Company, Schenectady, N. Y.*

A \$25 Bond Will Buy a Bazooka—Buy War Bonds—Keep All the Bonds You Buy

GENERAL  ELECTRIC
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Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.



low weight *thrust* for the GIANTS

The largest propellers to fly in this country—

18 foot 2 inch four-blade hollow steel Curtiss Electrics—efficiently harness the 3000 horsepower and more in the sub-stratosphere, yet increase the useful load of the airplane 650 pounds through weight reduction.

All of the propeller features pioneered by Curtiss are embodied in this installation, including automatic synchronization, reverse thrust, and of course, the unmatched durability of steel.

CURTISS ELECTRIC PROPELLERS

Curtiss-Wright Corporation, Propeller Division

LIGHTER MOMENTS with **fresh Eveready Batteries**

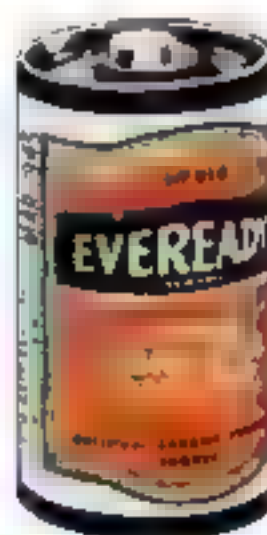


"It just comes natural to me, sir—I used to play an oboe with the philharmonic!"

"Keep your eye on the Infantry—the doughboy does it." The heavy fighting is up to him—the heavy saving is up to you. Buy War Bonds now and from now on!

MANY TIMES during this war your dealer has probably said to you: "Sorry—no 'Eveready' flashlight batteries." His reason is the best in the world—nearly all our batteries are going to the Armed Forces and essential war industries. The supply left over for civilians simply isn't enough to go around.

FRESH BATTERIES LAST LONGER . . . Look for the date line →



The word "Eveready" is a registered trade-mark of National Carbon Company, Inc.

FORMULA for GOOD WORK

"How do you mix your paints?" inquired an admirer of the work of a famous painter. "With brains," was the crisp reply.

The combination of "know how" and good tools is an equally effective formula for shop work. His years of experience have enabled the veteran machinist pictured here to recognize the best in files—and to "weed out" the inferior ones. For the exacting work he is doing, he uses Nicholson brands. His production is high, his work precise, his rejects few.

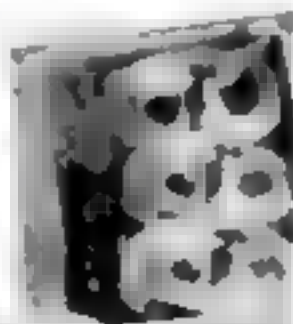
Nicholson Files will aid any mechanic's skill. Precision-shaped, precision-cut, precision-hardened, these world-famous files come through the factory in such uniformly high quality that Nicholson can safely guarantee *Twelve perfect files in every dozen.*

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FOR EVERY
PURPOSE

NICHOLSON
U.S.A.
MADE IN U.S.A.

Robot Mathematician

(Continued from page 222)

work rapidly and certainly with staggering numbers.

Basically, the figure factory is just an obedient army of little calculating machines. Important units of it are identical with apparatus perfected in I. B. M.'s laboratory for future use in commercial accounting machines. But these and other units are electrically connected at 2,000,000 points by 500 miles of wire.

Numbers are fed to this maze of wires and wheels by turning dials, by running appropriately punched ribbons of heavy paper into the machine, or by letting perforated cards slide over a sensitive mechanism. At one end of the switchboard there are 60 rows of 24 dials. Each row can be used to designate any number containing up to 23 significant figures; the twenty-fourth dial in each row is used to indicate an algebraic sign. Thus, five dozen numbers can be given to the machine by the dials. And even more such colossal numbers can be fed to it by ribbons or cards. Sometimes all three of these methods of supplying the calculator with numbers are employed simultaneously.

These numbers are never visible within the machine, but can be "stored," or held until needed, in any one of scores of places behind the switchboard. They are moved about within the machine in the form of electrical impulses. The impulse that designates a 1, however, is no different from the signal for a 9 or any other digit. It merely darts through the wires at a different split second during the revolution of a little wheel, and consequently stops another little wheel in a certain counter at a certain point during that wheel's revolution.

Orders to add, multiply, or perform any other operation with the numbers in the machine are given to the calculator by means of a separate ribbon of paper about three inches wide. Before being run into the robot, this tape is perforated in a device that resembles an enormous typewriter. The holes in the tape then tell the machine what the mathematician wants done. This control ribbon, however, does not convey any numbers to the machine; it merely carries the mathematician's instructions as to what is to be done with the numbers already in the works.

The control tape is placed around a spool on the front of the switchboard. As the machine pulls the tape forward, little brushes feel the holes in it and telegraph orders to other parts of the machine. As

(Continued on page 230)



This is a picture of 1150 round trips to the MOON!

This map shows the established routes over which the Air Transport Command has flown some half a billion miles.

LAST MAY marked the third anniversary of the greatest airlines operator in the world—the Air Transport Command of the U. S. Army Air Forces.

From a small beginning, the Air Transport Command has zoomed to proportions that dwarf your most optimistic ideas of what air transport can accomplish.

For the ATC operates some 125,000 miles of world-encircling air routes, using the services of 100,000 officers and men. Part of the personnel is supplied by private air lines, which are under contract to the War Department.

The distance covered by the ATC in a single month is more than 22 million miles—

equal to fifty trips to the moon—round trips!

ATC operations include the ferrying of airplanes to every



theater of war, and the transport of mail, bombs, ammunition, food, critical parts, medical supplies, and personnel. An important function is the evacuation of wounded. It is possible to fly a wounded soldier from China to Washington in 82 hours.

Flights across the Atlantic or Pacific are made many times daily. Special flights and deliveries are frequent, and often "save the day." The Flying Fortresses, for example, which were the Army's strik-

ing power in the Battle of Midway, were delivered by ATC on very short notice.

On return flights to America, cargo planes of the ATC may carry essential war materials such as tungsten, mercury, tin, platinum, black mica, quartz crystals, and others.

All these vital services are being performed by the Air Transport Command in hours and days, instead of days and weeks—a mighty important contribution to Victory.

It is also a preview of the wonderful things the world may expect from air transportation in the postwar period.

SPERRY

C O R P O R A T I O N

30 Rockefeller Plaza, New York 20

FORD INSTRUMENT CO., INC.

SPERRY GYROSCOPE CO., INC.

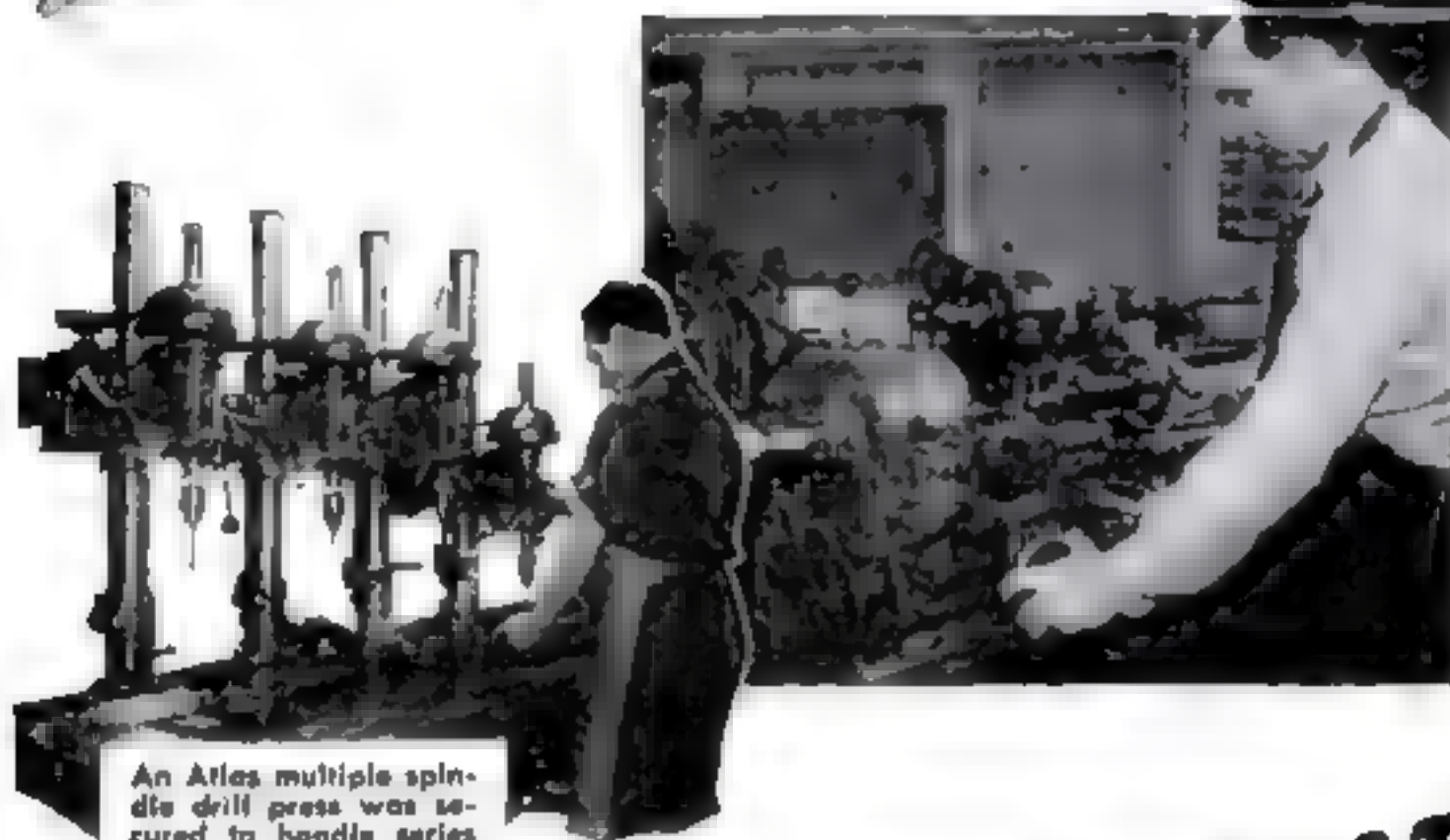
VICKERS, INC.

Waterbury Tool Division, VICKERS, INC.

with
Atlas



Compact Atlas milling machines handle all types of milling work.



An Atlas multiple spindle drill press was secured to handle series of drilling and tapping operations.

Atlas 10" lathes are the basic machine tool in thousands of shops.

AUTO SERVICE MAN BUILDS THRIVING BUSINESS PRODUCING VITAL WAR PARTS

Shortly after Pearl Harbor, Hugh Leaming decided he could do more for his country as a machinist than as service manager of a Rochester, N. Y. automobile agency. His first shop was just large enough to house his original equipment—an Atlas lathe, drill press, bench grinder, and shaper.

Working alone eighteen hours a day he finished his first contract for close tolerance gun parts on time and with such accurate workmanship that he obtained additional contracts quickly from prominent Rochester war producers.

Today, Leaming employs 21 men who work fourteen Atlas lathes, a milling machine, shaper and several Atlas drill presses.

Hugh Leaming's success story is typical of hundreds of men who have put Atlas precision tools to good use—in small shops—in basements—wherever space was available—making useful, profitable articles. Remember Atlas machine tools for YOUR postwar shop!



ATLAS PRESS COMPANY

1055 N. PITCHER ST., KALAMAZOO 13D, MICHIGAN

Tough

BUT

OH SO GENTLE



Want a new car? Well, you can't get one. So you'd better take good care of the one you already have.

Wear-wise car owners watch the engine. They know that oil-pumping is a sign of worn-out piston rings—that neglect can lead to serious trouble.

Millions have learned that Hastings Steel-Vent piston rings stop oil-pumping, check cylinder wear, restore engine performance and gasoline mileage.

When your motor specialist recommends new piston rings, it will pay you to install Hastings Steel-Vents.

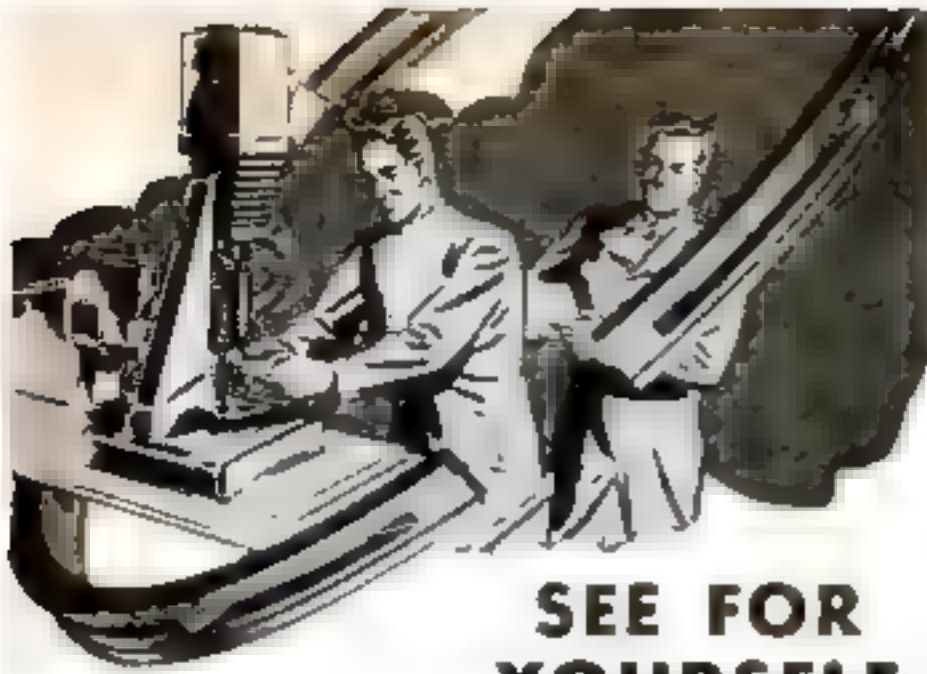
HASTINGS MANUFACTURING COMPANY • HASTINGS, MICHIGAN
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HASTINGS STEEL-VENT PISTON RINGS

TOUGH on oil-pumping • GENTLE on cylinder walls



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★ Now you can SEE why Burd "Graf-Flox" Piston Rings will give new life and add thousands of miles to the motor of your car or truck. Independent research laboratory photos* graphically show: 1. That Burd electric furnace iron has uniformly distributed natural graphite, scientifically controlled for maximum inherent self-lubrication. 2. That the troublesome abrasive metal particles always remaining on ring surface after grinding have been removed. This is done by an exclusive "Graf-Flox" method. 3. That another "Graf-Flox" process has applied penetrating colloidal graphite to further assure self-lubrication. These are the reasons why Burd "Graf-Flox" Piston Rings are instant seating—need no run-in . . . non-abrasive—do not scuff . . . self-lubricating—do not score, seize or stick in grooves . . . why they are pulling up engine re-ring, re-bore and re-claim performance records. Mail coupon for Burd "Graf-Flox" Handy Handbook and Car Economy Record Book. Sent free.



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NAME _____

ADDRESS _____

CITY _____ STATE _____



Robot Mathematician

(Continued from page 226)

the brushes pass a certain set of holes, for instance, they may send out word that a number in a certain unit is to be added to a number in another unit, and the result taken to a third unit. The machine will do this, then roll the tape forward to receive the next order and proceed to carry it out. Each foot of this control tape may bear orders for the machine to do 40 different things.

Problems such as this calculator handles cannot be answered with a single number. The answers to these problems are whole sets or families of numbers, from which a scientist may select a particular one for a particular purpose. These sets of numbers, or mathematical tables, are automatically typed out on a roll of paper in a typewriter located at one end of the switchboard.

Addition or subtraction takes the machine three-tenths of a second; multiplication, 5.8 seconds, and division 14.7 seconds. The machine, however, also works with roots, logarithms, all the trigonometric functions, all the hyperbolic functions, and functions of these functions. Operations which a person must have studied calculus to understand are performed by the robot in 88 seconds.

Just as a mathematician keeps books of tables on his desk and consults them while solving problems, the machine looks up numbers in tables, too. Three basic tables are stored in the machine all the time; others may be placed in the machine on perforated ribbons of paper. And such ribbons, incidentally, may be prepared by the machine for its own use. Aiken already has so many of them that he is perplexed about how to store them, but the more of them he has on hand the more useful his supercalculator becomes.

The long columns of figures typed out as the answers to problems may be photographed. Printing plates then can be made without risk of typographical errors. And scientists interested in the solutions to the problems presented to the machine may soon be able to obtain books that have been written by it.

The robot that writes these books of useful mathematical tables, however, will not demand any royalties. It works all the time and makes no more noise than a couple of busy typists. A two-horsepower motor keeps it grinding away, and it uses no more electricity—while solving problems that have baffled men for scores of years—than a fair-sized lathe or laundry machine.

INSIGNE OF THE CORPS OF ENGINEERS



WHERE PERFORMANCE REALLY COUNTS...



Dependable
... **CHAMPION**

SPARK PLUGS *ARE IN THE VANGUARD!*

When the Corps of Engineers take hold, things move. Masters, of every type of engine-driven vehicle and power equipment, dependability is the measure of everything they use. That's why Champion Spark Plugs are on active duty with the Engineers, as they are with every branch of our armed forces on land, water and in the air; for dependability

has been Champion's hallmark for more than thirty years. When you need new spark plugs, demand dependable Champions. Remember, too, that all spark plugs should be inspected, tested and cleaned at regular intervals for maximum engine efficiency and economy.

Champion Spark Plug Company,
Toledo 1, Ohio.



**TO SAVE
GASOLINE
—KEEP SPARK
PLUGS CLEAN**

BUY MORE AND MORE WAR BONDS UNTIL THE DAY OF VICTORY



But how do they make 'em so ROUND?

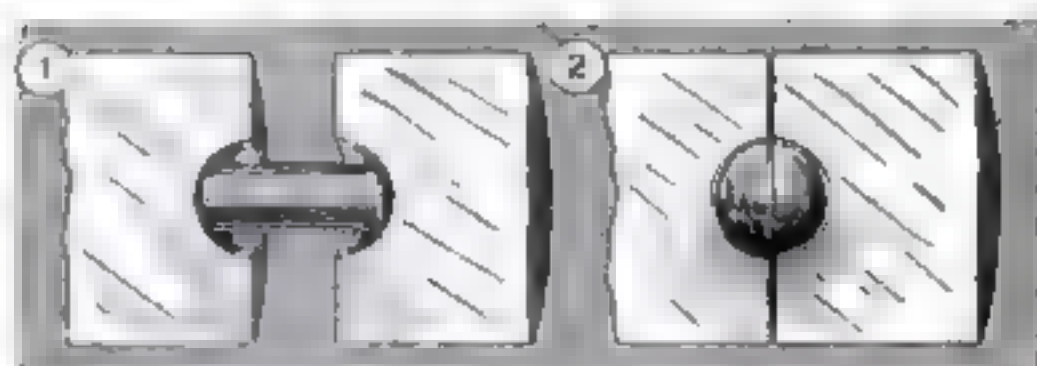
While the steel ball is only one component of a ball bearing, making a ball round (spherical) is the most interesting and least understood process.

In this limited space we show the principle that is used.

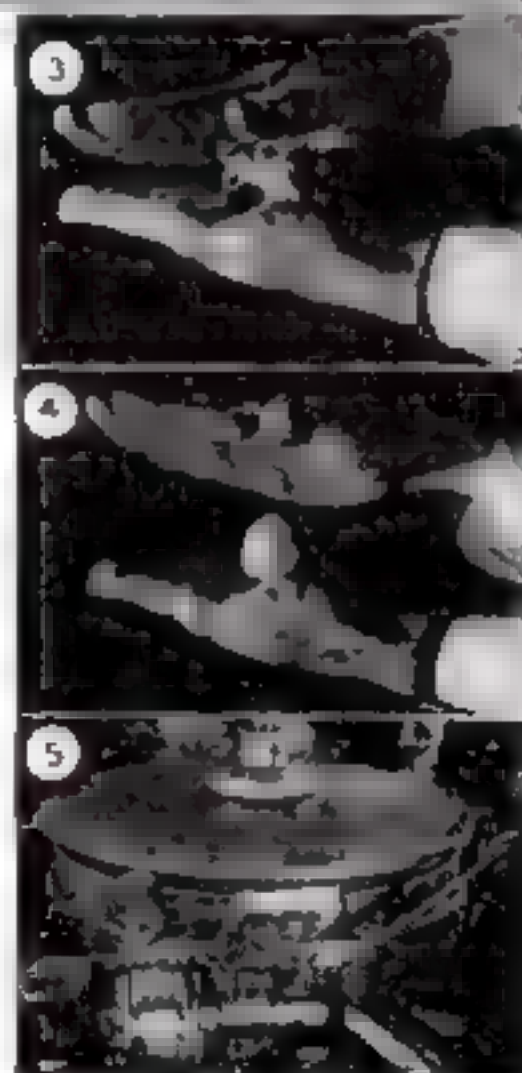
The extreme precision limits obtained (almost perfect sphericity, and diameter within .00005" of standard), and the wonderful strength and resiliency of the steel used are other subjects covered in more detail in a little booklet we would be glad to send you free. Ask for BM, "Making Them Round."



Cut-away
view of
ball bearing



1. Slug of steel wire is placed between accurately formed dies.
2. Dies forge slug into rough ball with minimum of "flash"
3. Successive grinding operations approximate motions in forming a ball of clay
4. Final grinding produces perfect sphere and correct diameter.
5. Final lapping operation polishes sphere to brilliant finish.



Nothing Rolls Like a Ball

NEW DEPARTURE
BALL BEARINGS

3291

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

Why This Kind Of Oil Heater HEATS YOUR HOME LIKE A FURNACE

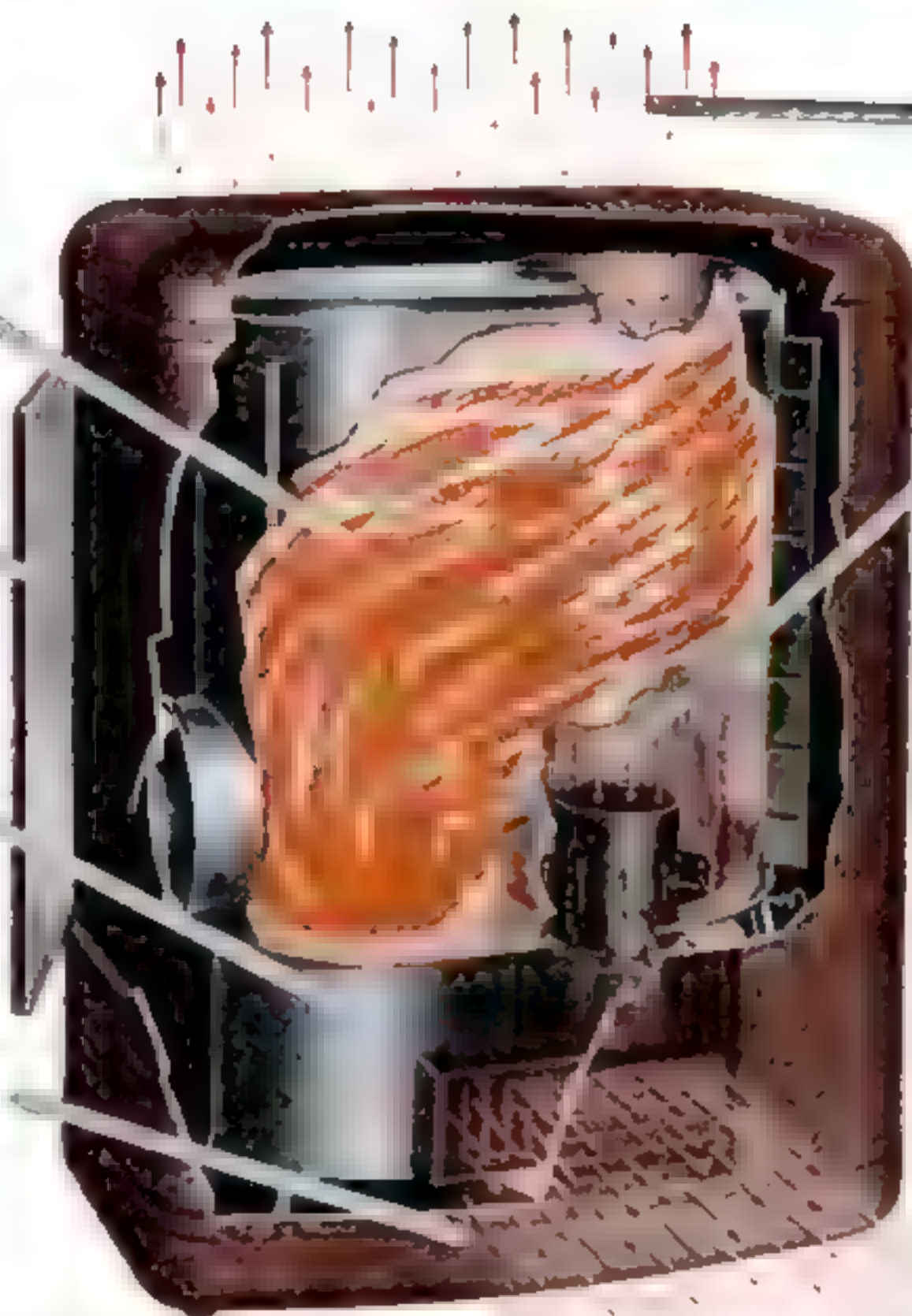
...And Brings You 3-Way Comfort From One Appliance

50% More Heating Area—and 50% longer flame travel—means more heat delivered into home, less heat lost up the chimney. Note heat-radiator fins—they help increase warm air circulation 25%!

Quick-Warm-Up Radiant Heat—the penetrating, "bone-warming" kind, floods out when you open these heat-reflector doors.

High-Efficiency Coleman Burner—For extremely clean-burning flame; low carbon, maximum heat from fuel. Low-flame fuel saver allows 50% lower adjustment for cool days.

Directed Warm Air-Flow Along Floors. Coleman Power Blower draws warm air from Hot Tube Radiator (upper right). Adjustable louvers direct this warmth where you want it!



Billows of Warm Air—through big open grill top. Outer casing is built to pull air like a chimney. Pulls in floor-level air for heating by big heat unit. Actually gives *forced* warm air without moving parts! Keeps floors warm, circulates freshly warmed air 3 to 5 times an hour!

Hot-Tube Radiator does two jobs!—Provides extra heating surface for warming more air—a bigger warm-air flow; supplies warm air for directed heat along floor through Power Blower.

All This, Plus Automatic Easel Burns clean, low-cost oil. No fuel dust, dirt, soot or ashes. Automatic controls available, so you "send the fire from an armchair," and get warm floors, even heat from floor to ceiling, and warmth that circulates through the house—not just one room!

FREE! The "Inside Story" of this and other "magic" heat plants, now being prepared for you by Coleman—oil heaters, floor furnaces, central plants, water heaters! They will be ready to provide new comfort in your home after the war. Write for it today!

THE COLEMAN LAMP & STOVE CO.
Wichita 1 • Chicago 11 • Philadelphia 8
Los Angeles 54 • Toronto, Canada



THE "HOT" NAME
IN HOME HEATING



The Coleman Lamp & Stove Co.,
Dept. SM-620, Wichita 1, Kans.
Without obligation, send me your **FREE** illustrated book, "The Inside Story of Tomorrow's Home Heating!"

Name _____
Address _____
Town _____ State _____



Are you a Workshop Beaver?

THEN you know the importance of sharp tools for doing better work more easily. Tools are easy to sharpen and to keep sharp if you know how—and use the right sharpening stone. Go to your hardware store for Sharpening Stones by Carborundum. For instance the No. 109 combination stone—One side is coarse grit for dull edges. The fine grit on the other side gives a keen, fast-cutting edge that makes the work easier!



*These stones are available
at your dealer's*

Write today for your free copy of the booklet "Short Cuts To Better Work For The Home Craftsman."

CARBORUNDUM

ABRASIVE PRODUCTS

Dept. S-104

THE CARBORUNDUM COMPANY

TRADE-MARK
Niagara Falls, N. Y.

(Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company)

Can We Ever Fly Faster Than Sound?

(Continued from page 75)

coverings, and flush riveting on military aircraft help to prevent the air from separating about the surfaces and bursting off in a shock wave. Engineers are working to develop airfoils in which the formation of shock waves will be delayed as much as possible. They have found that, for a given enclosed volume, a body composed of two parabolic arcs causes the minimum of energy to be spent in wave motion.

Of course, this would bring the tail right into the middle of the turbulence from the wing—unless the tail was placed ahead of the wing. Then the tail itself would produce a small turbulence to be felt by the wing. This might call for making the plane a flying wing.

At present, higher speeds can be made at lower altitudes without shock or compressibility waves being formed. This is possible because the speed of sound is greater at the lower levels. There is a 100-mile difference between sea level and 35,000 feet. (Above 35,000 it is constant, since the temperature is constant.) This difference will allow a plane at sea level in the neighborhood of 100 m.p.h. more speed before the critical speed at which the compressibility effect and waves begin to form, although at high altitudes this condition may still be encountered around poorly faired cowlings and fittings if the angles are sufficient to step up the air flow about them.

The possibility of fitting aircraft designs to the wave patterns formed is being considered, as is also the designing of planes to prevent wave formation. The airfoil needed apparently would have extremely thin entering and leaving edges with gentle curves between, which would require a minimum of air movement to allow its passage. The question now arises, whether such a wing designed for supersonic flight would be useful at less than these speeds. Such an airfoil might be testable in a high-speed wind tunnel, but its ability to provide lift at normal take-off speeds of 100 m.p.h. or less is another matter.

So far, we have very capably ducked the main problem in connection with supersonic flying. That is the matter of control of such an aircraft. The matter of control is a mighty ticklish one at speeds where the slightest movement of any part of the whole produces fantastic pressures and loads as well as more shock waves. Flying at super-

(Continued on page 240)

Going round in Circles

ABOUT WHAT BATTERY TO BUY ?



Buy the Battery Experts Choose

Be guided by the experts who choose batteries for the world's toughest transportation services. For example, the million-mile trans-ocean flying record was established by a Pan-American Clipper equipped with Auto-Lite batteries.

Auto-Lites, too, are specified for service with our

fighting forces in tanks, half-tracks, jeeps . . . wherever dependable power counts.

Get the long life . . . the extra power you need. Buy an Auto-Lite battery—specified as original equipment by leading automotive engineers.

AUTO-LITE BATTERY CORPORATION • TOLEDO, 1, OHIO

Manufacturing Plants at: Weymouth Falls, Atlanta, Indianapolis, Detroit, Oklahoma City, Toronto

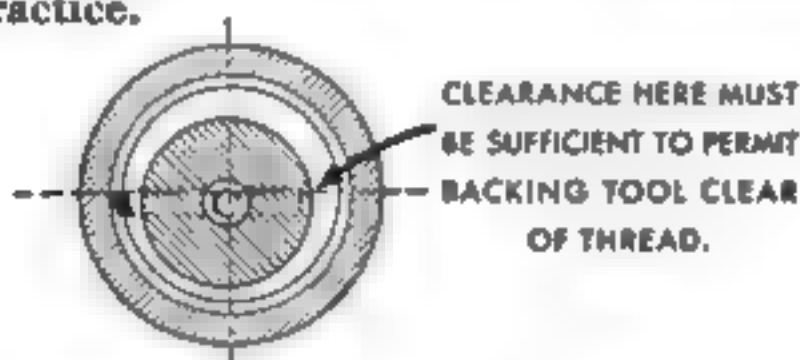


Tune in
AUTO-LITE'S
GREAT RADIO SHOW
STARRING
DICK HAYMES
IN
"Everything for the Boys"
Every Tuesday Night . . . NBC Network
Featuring stars of stage, screen and
radio and men and women at
the fighting fronts

AUTO-LITE BATTERIES

INTERNAL THREADING WITH WILLIAMS' BORING TOOLS

● Internal Threading on an engine lathe involves practically the same operations as external threading (described in another Williams Data Sheet) except for the tool used and its application to the work. Three types of Williams' Boring Tools are used extensively for internal threading. Instructions for the use of the three types illustrated are identical, and represent our recommended practice.



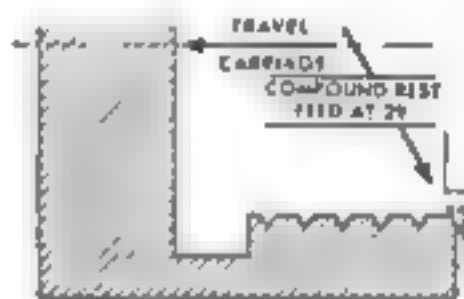
Since threading cutters are not regularly furnished with Williams' Boring Tools, the first essential is to provide a cutter bit ground to the proper angle, 60° for American National Threads. For internal threading more front clearance is required to prevent the heel of the tool from rubbing than is required for external threading.

The top of the cutter bit should be set at exact center as shown above, and a bar of

the largest practical diameter used in order to provide maximum rigidity. For right hand threading, the Compound Rest is rotated counter-clockwise (feed crank swung to right) and accurately set at 29°. Now mount the tool so that the bar is parallel to the lathe centers and align the cutter bit accurately with a center gage with the point of the bit to the wall nearest the operator.

With the work chucked or held on a face plate, right hand threading is done from the outer edge of the bore toward the headstock. Left hand threading is done from left to right, with the lead screw direction reversed.

Using the Compound Rest Screw (not the Carriage Cross Feed) feed into the work .002" to .004". Repeat until desired depth is attained, finishing off with depth of cut reduced to .001" on the final pass.



Action of the Thread Cutting Tool, with Compound Rest set at angle of 29°, is shown at left. Left side of Tool removes main chip which curls

clear better than when Tool is fed in at 90° angle. Right side of Tool merely shaves the thread smooth and helps produce a good finish.



WILLIAMS' ADJUSTABLE BORING-TOOL POST
4 sizes for bars 1/2" to 2-1/4". Height of bar easily adjusted with knurled ring.



WILLIAMS' LIGHT BORING-TOOL HOLDER
3 sizes for bars 1/8" to 7/16" diameter, and square cutters 1/4" to 3/8".



WILLIAMS' BORING-TOOL HOLDER

5 sizes for bars 3/16" to 1-1/8". Each takes many sizes of bars.



Williams' Boring Bars, and Cutters, Plain and Sleeve type, are also sold separately. 9 sizes, 1/2" x 7-5/8" to 2-1/4" x 34".



FREE DATA SHEETS

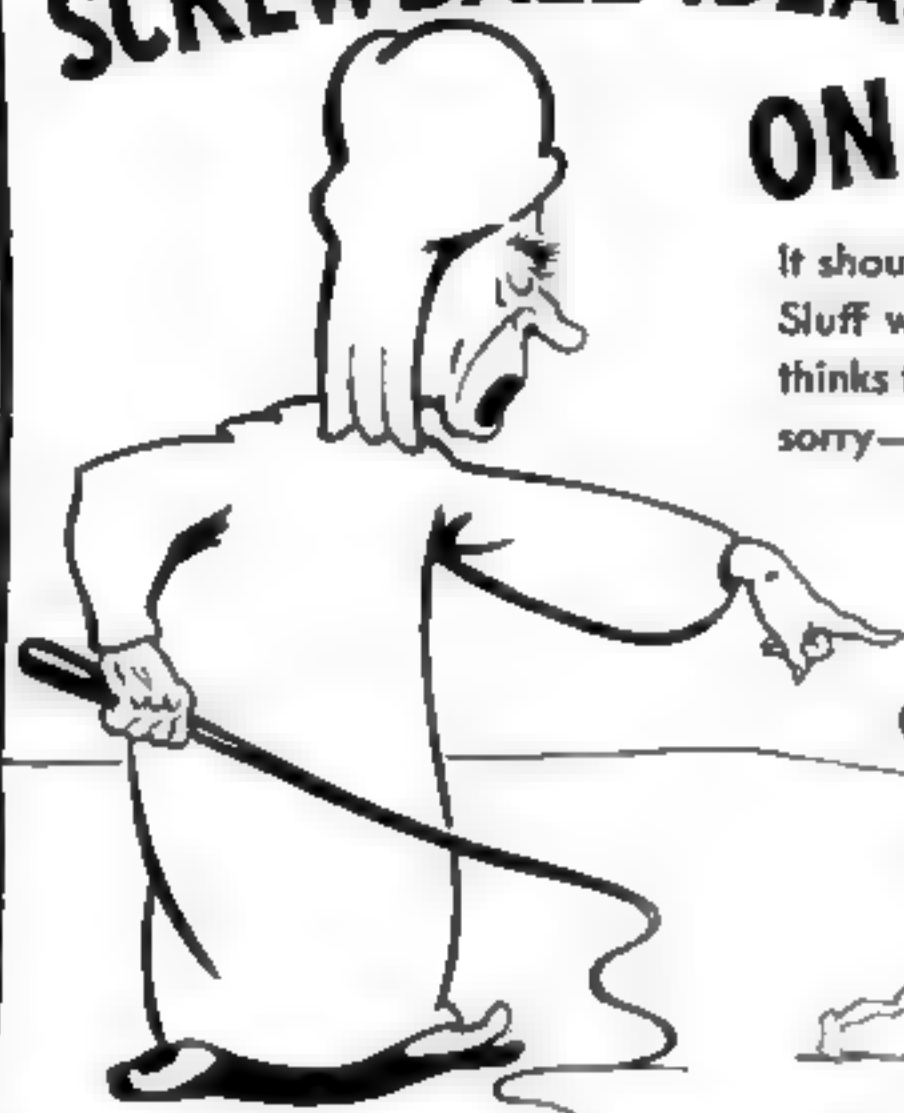
J. H. WILLIAMS & CO., BUFFALO 7, N. Y.
ON USE OF SHOP AND HAND TOOLS

Your name and address in the margin below will bring 12 Tool Holder Data Sheets (punched for 3-ring binder) and a list of our complete Data Sheet series. Mail to above address, Dept. PS-1044.

SCREWBALL IDEAS

ON BATTERY CARE

It shouldn't happen even to a camel! But Ardvark Sluff won't keep water in his battery because he thinks the water will dilute the electrolyte. He'll be sorry—when he has to buy a new one.



...EVERY BATTERY NEEDS A LITTLE EXTRA CARE THESE DAYS

WAR TIME is no time to neglect your battery! If restricted driving keeps your battery from getting its normal charge, see your Exide Dealer for an occasional **FREE CHECK UP!**

When necessary, he'll advise a recharge. At little cost, periodic recharges keep your battery strong and postpone the day when you'll need a new one. When you *must* buy, get a dependable, long-lasting Exide. Buy to Last—Save to Win.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

EXIDES ARE USED IN MORE THAN 100
APPLICATIONS BY OUR ARMED FORCES

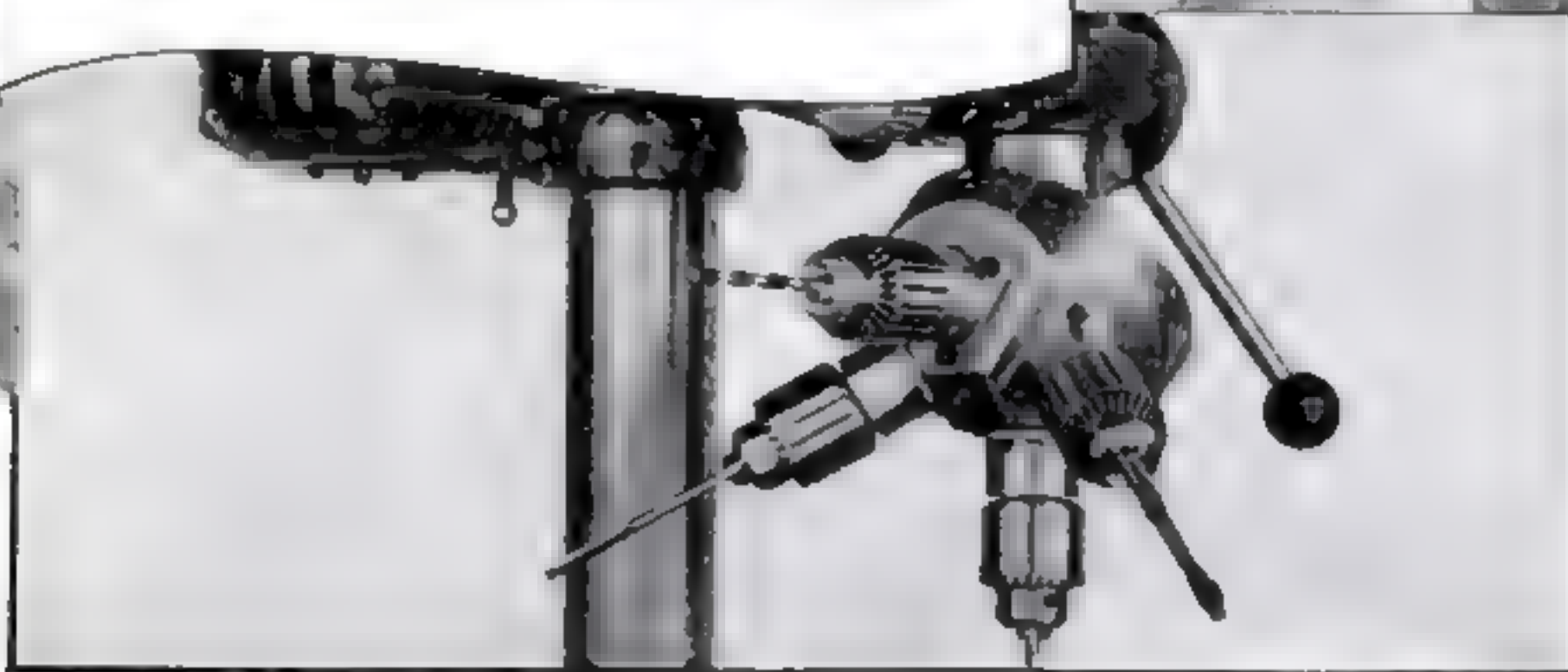


- 1 Don't buy *anything* you can do without.
 - 2 When you **MUST** buy, insist on dependable, long-lasting merchandise.
 - 3 Take care of the things you have. *Make them last!*
- These conservation rules save materials for war production, help curb inflation, give you more money to invest in War Bonds.



Ingenious New Technical Methods

Presented in the hope that they will
prove interesting and useful to you.



Amazing New Four Spindle Turret Attachment for Drill Press!

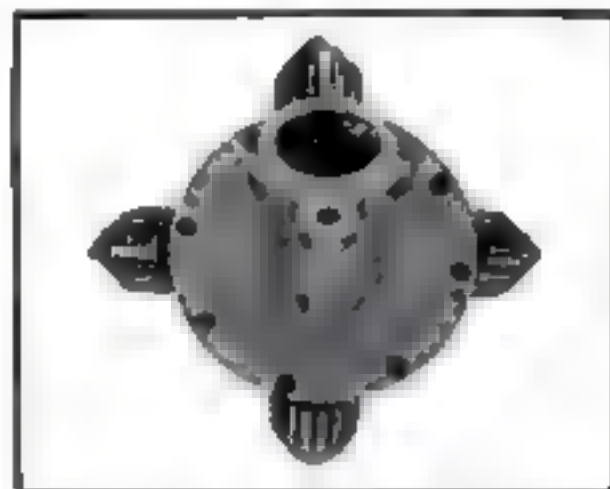
Now one drill press can do the work of four and, at the same time, effect a savings of up to 75% in floor space, with the "Quadrill" attachment. This rotary device will accommodate four boring or cutting tools at the same time, yet one tool *only* is in motion when the head is in operating position.

The entire unit is assembled to the quill of the drill press and is driven from the drill press spindle. Accuracy and rigidity of alignment of the "Quadrill" are assured by the special construction of the driver and spindles, thus efficiency is only limited by the accuracy and power of the drill press itself.

Foolproofing in indexing is accomplished by visual markings and by the relationship of the index pointers on the index disc, as well as the extension of the spring retainer. Four hardened and ground spindles are fitted for No. 32 Jacobs chucks or their equivalent. To provide correct positioning at all times, the entire spindle assembly is located by means of an accurate fitting of recess and undercut, between turret and bearing housings. The hardened friction starter and driver have been so constructed that at any speed proper synchronization of the driver teeth is accomplished without clashing.

It goes without saying that our fighting men must have the finest possible quality materials home industry can produce. So, although the stock of quality raw materials from which Wrigley's Spearmint chewing gum is made is growing steadily smaller, they are still maintaining pre-war standards. However, they can now make only a portion of their former output, so all of this limited production is going to our fighting men and women overseas only . . . where it is an "on-duty" need.

You can get complete information from Chicago Driller Corporation, 919 North Michigan Avenue, Chicago 11, Illinois



Quick and positive indexing assured
by pointers on index disc



Quadrill assembly complete ready
for attachment to drill press

Y-143

Fix these words in your mind:

Zenith Specializes in

"RADIONICS EXCLUSIVELY"



**This Zenith Policy
is your assurance of the World's Finest
in your coming New Radio**

SAY THAT WORD, "RADIONICS" out loud. It sounds just like what it means... a compound of radio and electronics which includes many new, secret developments born in the heat of wartime necessity.

It's a broad field, RADIONICS. A field so revolutionary and fast-moving that it requires complete concentration to remain its master. That's why Zenith specializes in "RADIONICS EXCLUSIVELY." No spreading out into unrelated fields like refrigerators, washers, electric irons, cooking ranges and vacuum cleaners. Zenith has no intention of competing with lifelong specialists in those fields.

This policy of "RADIONICS EXCLUSIVELY" has made Zenith one of the largest Radio manufacturers in the world.

It is the reason why millions of owners of pre-war Zeniths are still enjoying top radio performance with least service expense.

And it is the reason why today, down vast Zenith production lines, flow record numbers of superbly performing Radionic devices for the armed services—many of them so "hush-hush" they can only be hinted at. They are not only helping to save lives and win battles but they are also doing their jobs un-

der the most severe fighting and weather conditions.

SO, OUT OF WAR'S proving ground—out of Zenith's background of "RADIONICS EXCLUSIVELY"—will come the finest in radio for you. For through unrivaled war work and years of experience in "RADIONICS EXCLUSIVELY" Zenith has won unquestioned leadership in High Frequency—the basis of FM Radio, Television and Short Wave. Remember—it was Zenith that years ago introduced short wave communication into the U. S. Navy.

MARK these words... the Zenith Radionic Revolution is on its way! Watch for it in the coming new Zenith Radionic Radios, Radio-Phonographs, and Global Portables. It's an exclusively Zenith revolution that will begin a new era of engineering advancement and precision quality at low cost... a revolution that assures you greatest value per dollar in the coming new radio for your home!

Keep your eye on Zenith for the best in radio... and see Zenith first.

ZENITH RADIO CORPORATION, Chicago 39, Ill.
All Production Now for War or Rehabilitation

COPYRIGHT 1944, ZENITH RADIO CORP.

Keep Your Eye on **ZENITH** *for the Best in Radio!*

OLD TIME RADIO

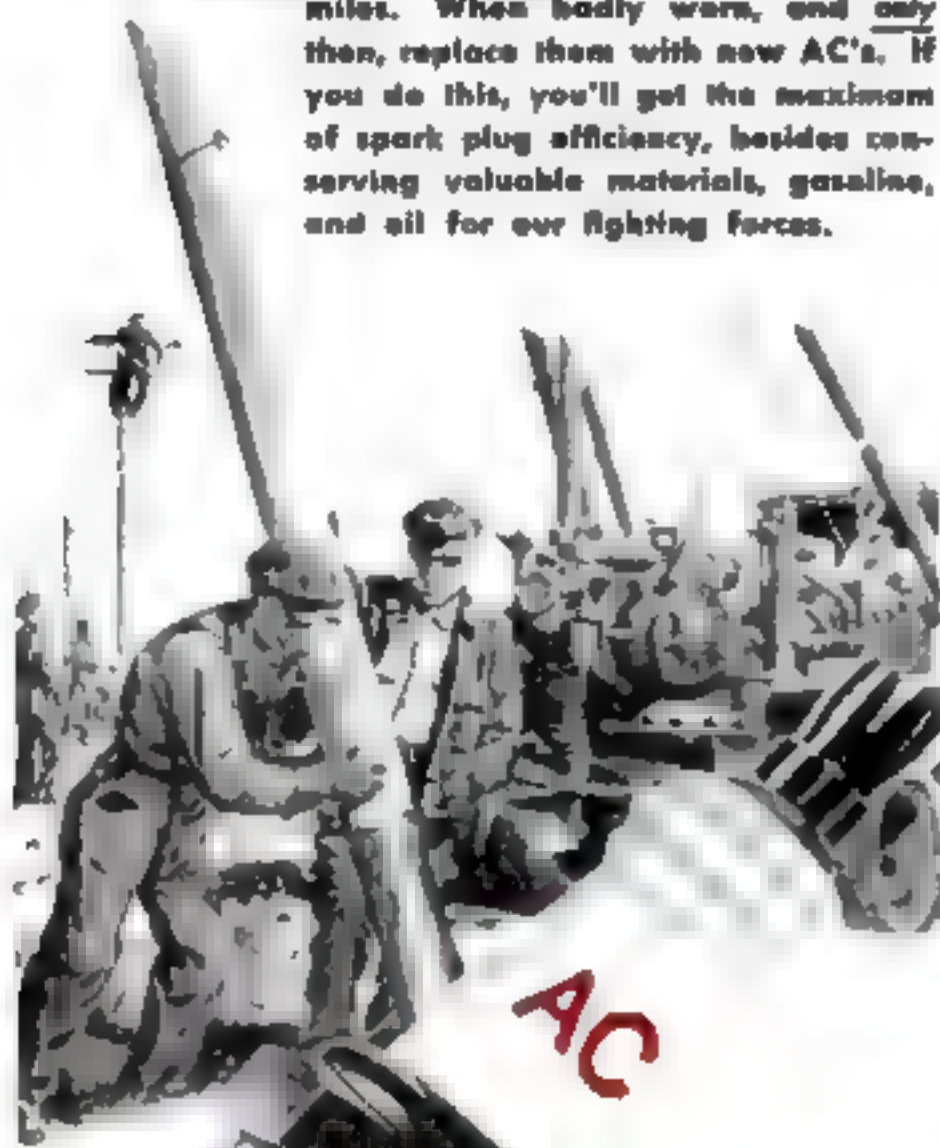
RADIONIC PRODUCTS EXCLUSIVELY—
WORLD'S LEADING MANUFACTURER

RADIO • FM • TELEVISION • RADAR • SHORT WAVE • RADIO-PHONOGRAPHS • HEARING AIDS

Reliability is the very life of the great public utilities. The public demands reliability from them. They, in turn, must have it in all their equipment.

Like millions of motorists, many utilities get the utmost in reliability from AC Spark Plugs, which help to keep their maintenance vehicles ready and efficient,—day and night, in rain, or snow, or summer heat. And to insure top performance, and long life, they clean and adjust those spark plugs every 3,000 miles.

Profit by the example of these experts. Have your spark plugs cleaned and adjusted every 3,000-5,000 miles. When badly worn, and only then, replace them with new AC's. If you do this, you'll get the maximum of spark plug efficiency, besides conserving valuable materials, gasoline, and oil for our fighting forces.



CLEAN SPARK PLUGS
SAVE UP TO ONE GAL-
LON OF GAS IN TEN



SPARK PLUGS

**BRING YOUR SOLDIER HOME SOONER
BUY ANOTHER WAR BOND**

Can We Ever Fly Faster Than Sound?

(Continued from page 234)

sonic speeds in straight, level flight is one thing, but maneuvering at these speeds is quite another. It is possible that pressure-changing devices, such as spoilers, will have to be incorporated in the design. It may be that jet impulses will have to be utilized to nudge the aircraft onto another course with gentle pushes against the airflow. No one knows at the present time.

As we have mentioned, the power to attain these speeds is another problem. While gravity helps in a terminal-velocity dive (the only way we can now even approach the speed of sound with an aircraft as an entirety), reaching these speeds in level flight with the present power plants seems to be an impossibility.

In addition to power and controllability, we must have strength. Our supersonic aircraft must be able to withstand these tremendous pressures and shock-wave buffetings. The pilot must be adequately protected, for failure of the structure would present him to a 700-m.p.h. air front, which would make bailing out anything but the harmlessly exciting thing it is now.

The writer asked one authority what would be the effect on the human body of bailing out at supersonic speeds. The written reply was the one word "AWFUL!" underlined several times.

Now that we are at the beginning of a new phase in the conquest of the air, we must proceed cautiously. We are entering an entirely new field of exploration—a field in which tragedy may await the unwary. Undoubtedly, there will be occasional unpremeditated forays into this unknown territory, and it will be up to the men who make them to add to the general fund of knowledge through careful analysis of their experiences. One by one the small barriers will be removed, so that the whole picture of supersonic flight will become clearer. Eventually, we shall be able to travel at speeds that now seem eternally impossible—just as present-day speeds might have seemed to the Wright brothers.

DON'T WASTE PAPER!

It's needed for packaging blood plasma, ammunition, and rations for our fighting men overseas. Every pound you can salvage brings nearer the day of victory and peace.



Speed Nuts ABSORB VIBRATION

One of the deadliest enemies threatening the life of most products is VIBRATION. The only self-locking nut that conquers destructive vibration by ABSORBING it, is the SPEED NUT.

Made of LIVE spring steel, accurately heat treated, the SPEED NUT has two arched prongs that cushion and ABSORB the most severe vibration, to definitely prevent vibration loosening.

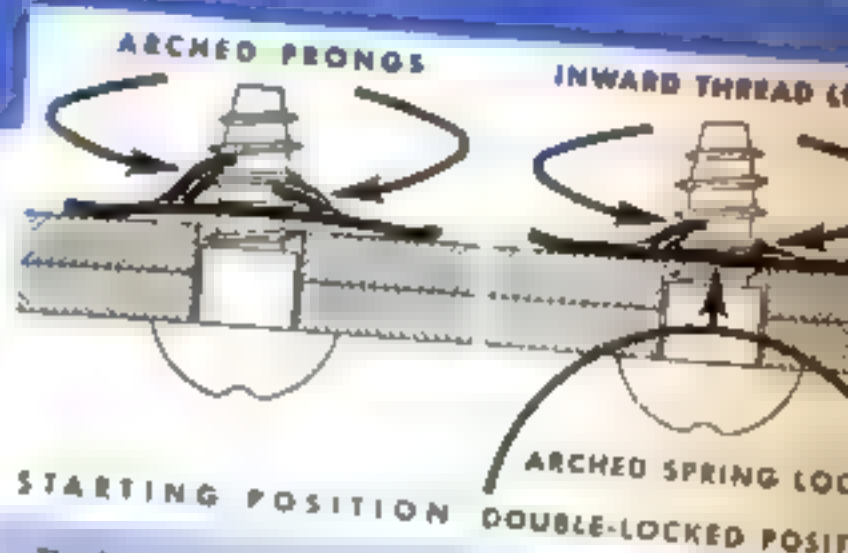
In addition, SPEED NUTS are extremely light in weight. They are quickly and easily applied. And they cost considerably less than other fasteners.

Small wonder, then, that millions of SPEED NUTS were used prior to the war, on automobiles, radios, stoves, refrigerators and thousands of other products . . . more are being used today on all types of military equipment . . . and more than ever before will be used after the war is won. A brief letter will bring you full details.

TINNERMAN PRODUCTS, INC.
2022 FULTON ROAD CLEVELAND 13, OHIO

In Canada: Wallace Barnes Co., Ltd., Hamilton, Ont.

In England: Simmonds Aerocessories, Ltd., London



The base and the prongs of the Speed Nut remain well arched and there is no installation torque as the screw quickly turns into the Speed Nut to starting position.

As the screw is tightened the arch of the base is reduced and the prongs are forced deeper into the root of the screw thread to provide a double-locking action.

Speed Nuts
[PATENTED]

*Trademark Reg. U. S. Pat. Off.



Many parts of the Liberator are bonded together with an incredibly strong adhesive called Metlbond, devised by the Consolidated Vultee Development Engineering Department.

Confidentially, it sticks!

NEVER BEFORE has it been practical to...

...cement steel to aluminum...
 ...cement wood to rubber...
 ...cement plexiglass to aluminum...
 ...cement steel sheets to plastics.

BUT METLBOND does all these things! This revolutionary adhesive, devised by the Research Laboratories of Consolidated Vultee, sticks almost anything to anything

with almost twice the strength of standard rivets!

Metlbond is so new that uses for it have scarcely begun to be explored. After the war it will be widely used in industry and possibly in the home.

Meanwhile, Metlbond represents only one of a series of improvements which guarantee that Liberators and other Consolidated Vultee airplanes keep getting tougher and tougher.

CONSOLIDATED VULTEE AIRCRAFT

LIBERATOR CORONADO CATALINA LIBERATOR EXPRESS VALIANT VENGEANCE RELIANT SENTINEL

San Diego, Calif.	Fairfield, Calif.	Fort Worth, Texas	Nashville, Tenn.	Wayne, Mich.
Allentown, Pa.	Vultee Field, Calif.	Tucson, Ariz.	New Orleans, La.	Louisville, Ky.
Dearborn, Mich.	Elizabeth City, N. C.	Miami, Fla.	Member, Aircraft War Production Council	

Sailing into the pages of history

Fast PC ships and Destroyer Escorts clearing the U-Boat wolfpacks from the convoy lanes . . . husky LCI (L) Landing Craft smashing through to the landing beaches! These are new immortals of the sea . . . sailing into history with the Constitution, the Monitor and the Oregon! Making history, too, are the people who build these modern warcraft. Here at Defoe, record-breaking construction methods are saving priceless days in delivery time. Only craftsmen who build well can measure up to the shipbuilder's standards. They must work with plenty of heart and pride. So you may be sure whatever this organization produces after the war will embody exceptional quality and value for peacetime America.



DEFOE SHIPBUILDING COMPANY, BAY CITY, MICHIGAN



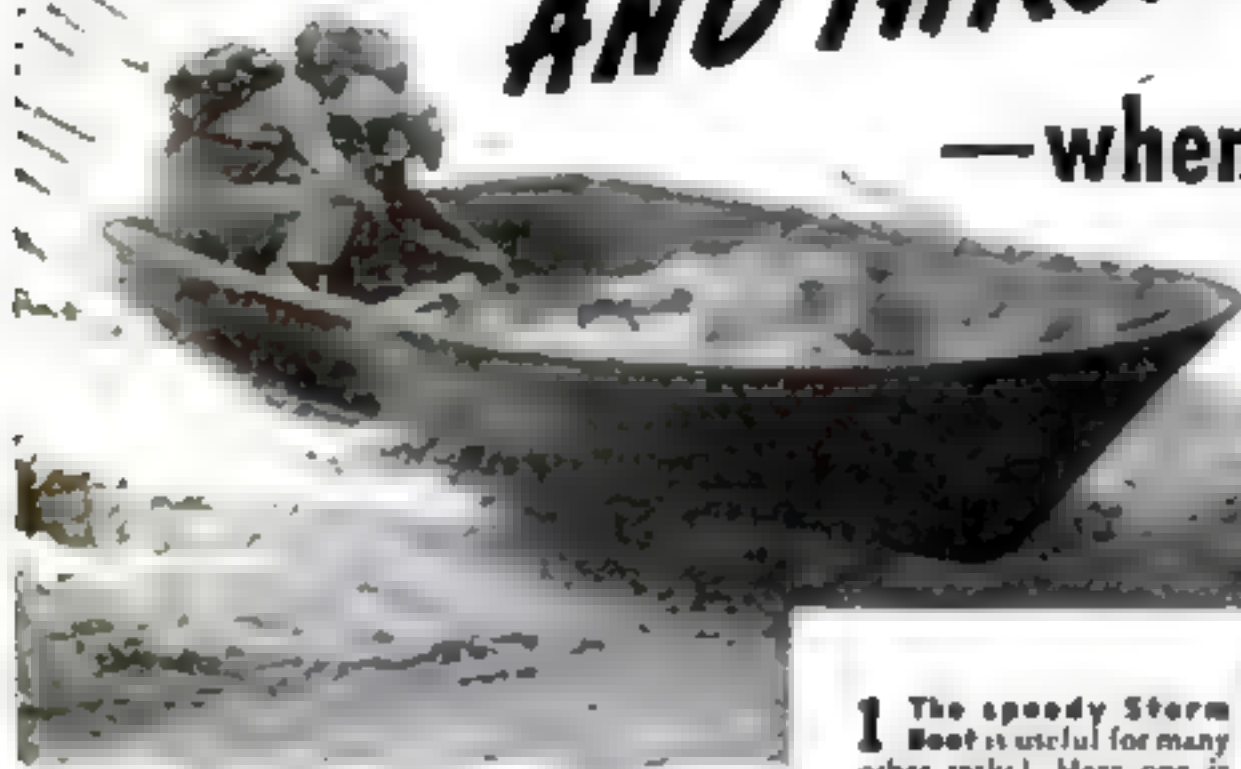
*Four White Star Renewal Citations
now decorate the Navy "E" Award
won by Defoe workers.*

INVEST IN INVASION
—BUY WAR BONDS

SHIPS FOR VICTORY
SERVANTS FOR PEACE

IT'S HEADS DOWN AND THROTTLES WIDE

—when the Storm Boats
hit the beach!

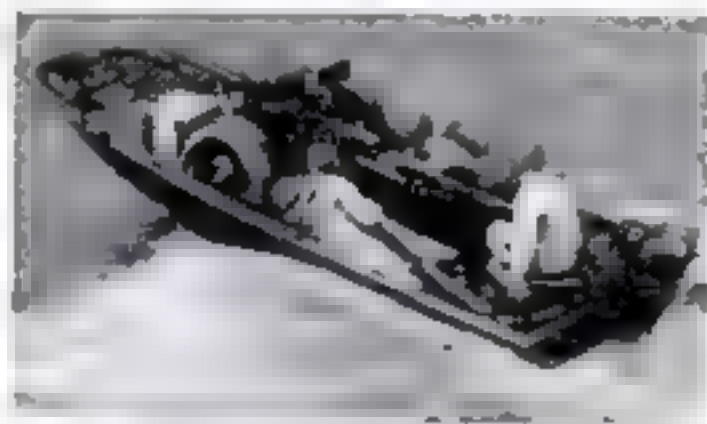


BELLY-flat and heads down, nearly a ton of rugged fighting men and their battle gear cover the bottom of each racing Storm Boat when it slashes for the beach — hits the shore — leaps bodily from the water and disgorges its crew!

High speed, and the darting maneuverability of an angry hornet are the Storm Boats' defense against hostile fire. The great Evinrude "storm boat motors" provide both, make the Storm Boat one of the most spectacular of small assault craft.

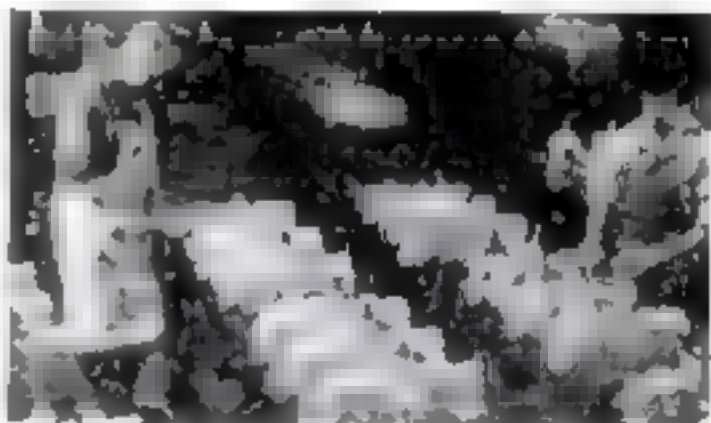


1 The speedy Storm Boat is useful for many other tasks! Here one is shown tearing over the water loaded with a 37-mm antitank gun, together with two-man gun crew, ammunition, and the operator. Machine gun squads and mortar squads are among other standard storm boat "cargoes"



2 Storm Boat on petrol. The hull draft is only a few inches, and like all other Evinrudes the big motor tilts readily over obstructions, making the storm boat adaptable for operation in the shallowest of waters. The bottom is well compartmented to make the boat practically nonsinkable.

3 The high efficiency of the storm boat motor has won for it other important assignments. Here are storm boat motor power heads specially built to power high-capacity portable pumps . . . "last-ditch" fire fighters for use when a ship's main fire-fighting equipment has been blasted out of action!



All of Evinrude's facilities are now devoted to production for Victory. With peace there will be sparkling new Evinrudes for all to enjoy. EVINRUDE MOTORS, Milwaukee 9, Wisconsin.

EVINRUDE

OUTBOARD MOTORS

Every Dollar You Invest Helps Speed Victory — Buy More Bonds



What a Champion

FOR MORE than 43 years Indian has held the lead for speed, endurance, instant ease of handling, unmatched power . . . and for every other factor that assures safety, comfort and all 'round dependability.

Indian's perfection and performance have earned the plaudits of motorcycle owners and riders everywhere . . . sports-lovers and safety officials alike, thanks to Indian's engineering leadership, better materials throughout its entire construction, superior principles of design : : : and constant improvement.

No matter where the road may lead . . . or what the demands may be . . . you will get there quicker, with lots more pleasure, at much less cost if your choice is the safer, better Indian . . . "The Champion of Them All."

Indian Motorcycle Company, Springfield, Massachusetts

New thousands will thrill to the joys of motorcycling when Indian surprises America with postwar improvements. Send us your name and address on the coupon below . . . so you will get the good news just as soon as it's announced.

Mail the coupon today.

BUY WAR BONDS NOW TO BUY AN INDIAN LATER

Indian Motorcycle Co., Springfield, Mass.

Please send me Indian News . . . and put my name down to receive any new Indian announcements.

PS-10

Name.....

Address.....

City..... State.....

Indian

MOTORCYCLES

*Read
about
Motorcycling*

OCTOBER, 1944

Buy War Savings Bonds and Stamps regularly.

245

**"A Thing of Beauty
AND A
(SMOKING) Joy Forever!"**

Just as fine embroidery deserves fine linen, so fine pipe craftsmanship deserves fine briar!

There is no substitute for imported briar from the Mediterranean region. So that's the material we give the master pipe-makers of LHS to work with—that and solid rubber bolls, sterling silver bands, and years of pipe-making "know how."

LHS

STERNCREST

STERLING

\$5

Smooth and Antique-Finish . many handsome models, each one numbered, registered and guaranteed by LHS.



No. 12
Golf Model

LHS

14K

We select briar of rare grain and beauty, circle it with solid gold, and offer the Sterncrest 14K to the ultra-discriminating who want to own, and **\$750** give, the ultimate in pipes.

All good pipe dealers carry LHS famous pipes

L. & H. STERN, INC., Stern Bldg., Brooklyn 1, N. Y.

Makers of **LHS** Ultra-Fine \$10 and Purse Pipes \$2.50, \$1.50

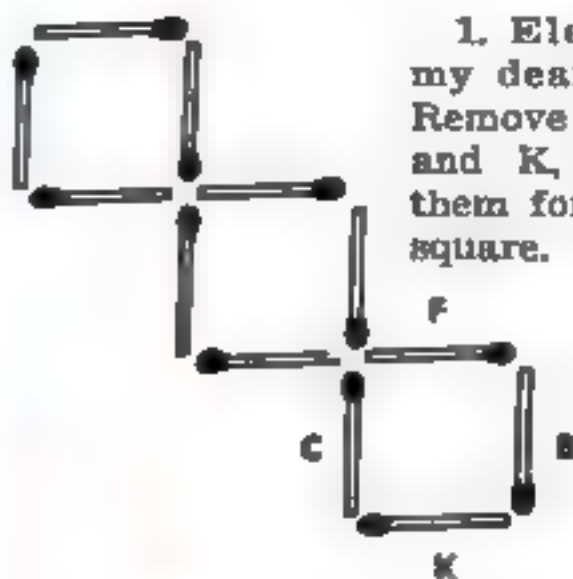
YOU WILL UNDERSTAND—Thousands of LHS pipes are now going to the armed services. If you can't always locate the LHS model you want, remember, any LHS is "Perfection in a Pipe."

Put this in your pipe and smoke it.

BUY WAR BONDS

SOLUTIONS TO MATCH PUZZLES

(See page 90)

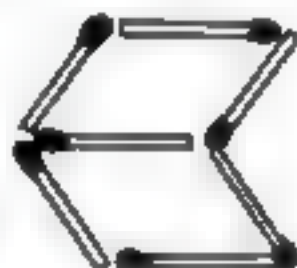


1. Elementary, my dear Watson. Remove B, C, E, and K, and with them form a third square.



2. Interlaced thus, the matches will overlap the glass edges by a quarter inch, and will easily carry the weight of a wineglass.

3. Who said anything about separated diamonds? These happened along as Blame twins, but they're still diamonds.



4. Drop water on the fracture in the match, which will then swell and spread out fanwise, thereby allowing the coin to drop with a pleasant clink into the bottle.

5. Anyway, this is what makes the world go round, and if matches aren't made of love, it's just too bad for everyone concerned.



Sugar Core for Golf Balls

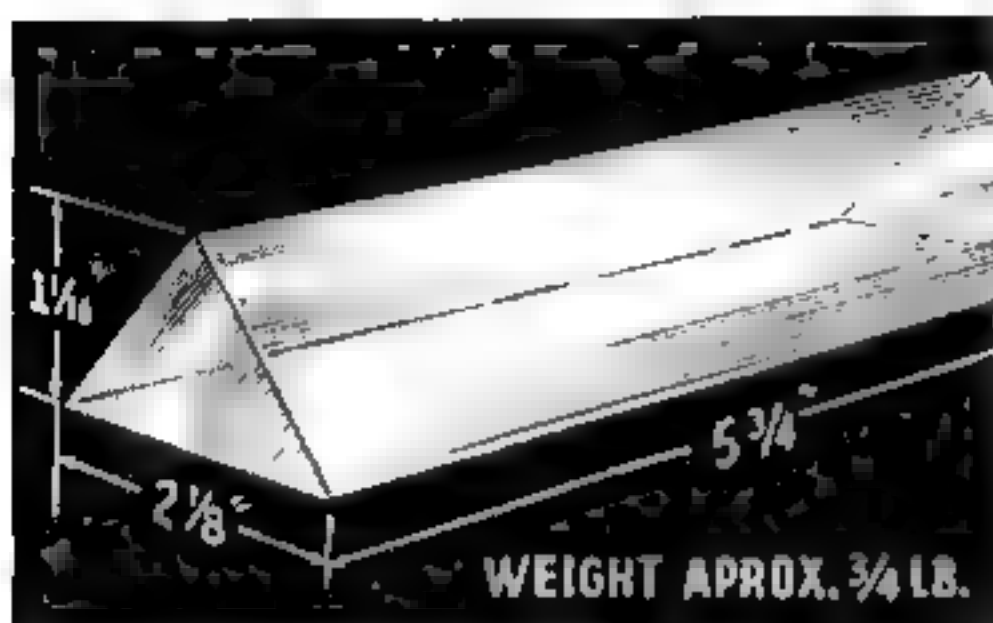
SUGAR and water may be used in making golf balls after the war. Dr. Richard A. Crawford, a research scientist of The B. F. Goodrich Company, Akron, Ohio, has devised a new manufacturing method that will substitute this liquid mixture for the familiar solid core that has formed the center. Liquid cores are said to be superior to solid, and the inventor claims that his will not solidify even at low temperatures.

SENSATIONAL WAR BARGAINS IN LENSES & PRISMS

**YOU CAN EASILY MAKE Telescopes—Periscopes—Magnifiers—
Photographic Gadgets—and do Hundreds of EXPERIMENTS**

Our Policy On War Surplus . . . We are cooperating to move war surpluses while the war is on. This is an exceptional purchase opportunity for all who may be interested, including Schools, Colleges, Amateurs, Researchers, etc.

All Items Finely Ground and Polished but Edges Very Slightly Chipped, which We Guarantee Will Not Interfere with their Use



TANK PRISMS

In order that the tank driver shall not get shot in the face, two of these Silvered Prisms are used to make a periscope (without magnification).

We have secured a number of these that are very slightly chipped, making possible their sale at a very low price. They are 90-45-45 degree prisms of huge size—2 1/4" long, 2 1/8" wide, finely ground and polished. Other uses for these Prisms: Experimental Optics, Optical Instruments and Gadgets, as unique gift item, unusual paper weight, desk name plate, etc. Normally these Prisms would retail from about \$24 to \$30 each.

Stock No. 3004-N . . . **SILVERED TANK PRISM**—Price \$2.00 each Postpaid.

Stock No. 3005-N . . . **PLAIN TANK PRISM**—Price \$2.00 each Postpaid. This one is excellent for projecting all the colors of the spectrum—a beautiful sight.

FOUR PRISMS—Special—\$7.00 Postpaid
... This is the most sensational bargain we have ever been able to offer.

SPECIALS IN LENS SETS

... the unique Xmas Gift, popular with Servicemen! Big 10 Page Project and Idea Booklet with all sets—describes successful developments—points the way to new experiments.

Set No. 301-N "Our Advertising Special" 12 Lenses for \$1.00 Postpaid. For making your own powerful telescopes, low power microscope, strong magnifiers, drawing projector, photo cells, telephoto lens, dummy focusing camera, Kodachrome viewer, stereoscopic viewer, ground glass and enlarging focusing aids. For experimental optics, portraits of babies and small pets, copying, ultra close-up shots, and many, many other uses.

Set No. 305-N "The Gadgeteer's Delight" 33 Lenses for \$5.00 Postpaid. Contains all the lenses in the above set plus twenty more expensive lenses increasing your field of experiment and gadget making. All our lenses are neatly packed and marked.

Set No. 310-N "The Experimenter's Dream" 60 Lenses and New Complete 50 Page Booklet—\$10.00 Postpaid. Contains all the lenses in the above sets plus 25 others that makes this a sensational buy. The variety of lenses in this set will enable you to conduct countless experiments and build a wide variety of optical equipment.

New 50-Page Illustrated Idea Book . . . \$1.00 Postpaid. "Fun with Chipped Edge Lenses" describes a wide variety of uses for our lenses and contains much information especially designed for beginners in optics.

PROJECTING LENSES

16 MM. Achromatic Projecting Lenses. Set No. 4002-N . . . consists of 2 cemented achromats, 18.5 MM. diameter with effective focal length of 2". Originally mfg. for U. S. Government . . . \$4.00 Postpaid.

35mm Slide Projecting Lens Set—No. 4004-N . . . \$1.50 Postpaid. (May also be used for enlarging 35mm to 2 1/4 x 2 1/4 Film) Consists of 2 uncemented achromats 1 1/4 inches in diam. Mounting directions and cement supplied Free.

MAKE YOUR OWN TELESCOPE

Complete set 5 matched Achromatic Lenses, originally produced for U. S. Navy gunscopes—3 1/2" Power. Order No. 2000-N . . . \$11.00 Postpaid.

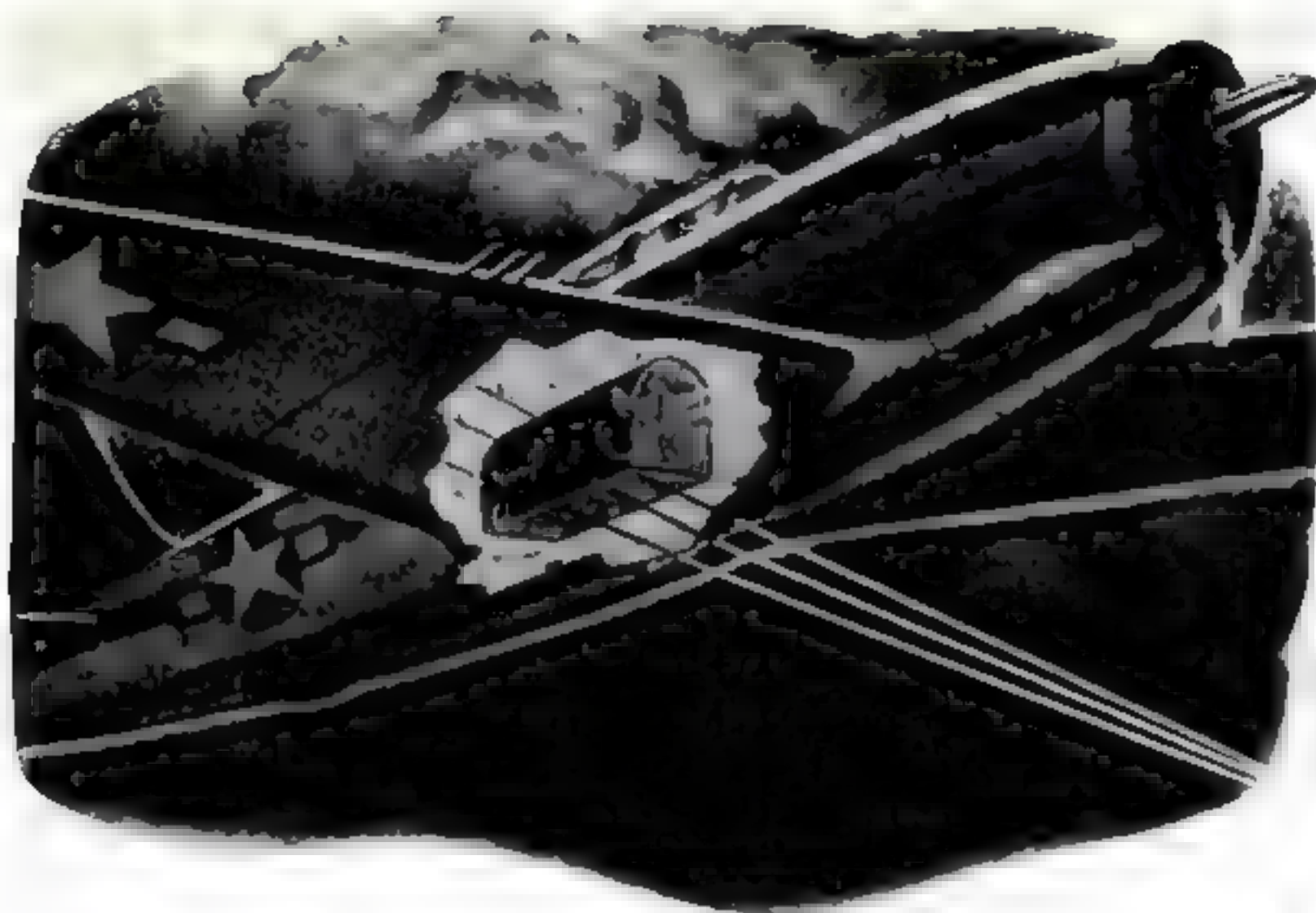
LENSES for ENLARGING

Picture Size	We Recommend	Price
35 mm.	Stock No. 6097-N	\$1.50
2 x 2	" 6023-N	.75
2 1/4 x 2 1/4	" 6023-N	.75
1 3/8 x 2 1/2	" 6023-N	.75
2 1/4 x 3 1/4	" 6023-N	.75
2 1/2 x 4 1/4	" 4003-N	.75
3 1/4 x 4 1/4	" 4003-N	.75
4 x 5	" 4003-N	.75

Satisfaction Guaranteed • Minimum Order \$1.00

EDMUND SALVAGE COMPANY

27 W. Clinton Ave., Dept. 10, P. O. Audubon, N. J.



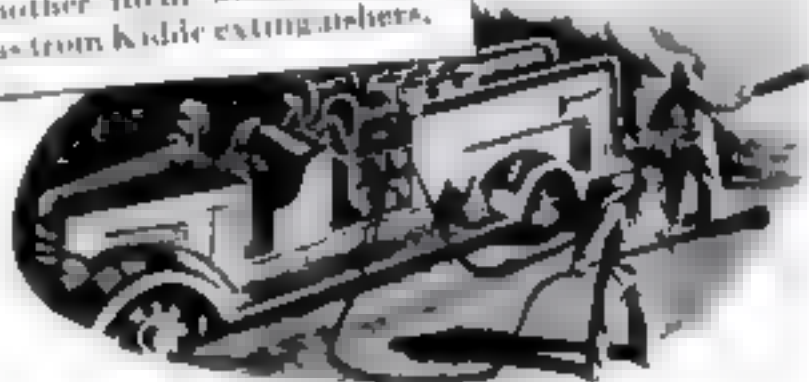
Taking the heat off tracers—before they hit!

Explosive fumes from gasoline tanks, ignited by tracers, could easily blow up, send plane crashing in flames. So our pilots flood area around tanks with carbon dioxide gas from Kidde cylinders. Fire-smothering carbon dioxide replaces dangerous vapors, robs enemy tracers of incendiary effect.



Horsepower in a package! Tremendous energy, available instantly at the turn of a valve, is provided by carbon dioxide, stored in Kidde cylinders.

Gas blasts out crash fires! Gasoline fires die suddenly when airport crash trucks smother them under carbon dioxide gas from Kidde extinguishers.



Gases-under-pressure, harnessed by Walter Kidde & Company, are serving our fighting men in many ingenious ways. After the war they'll serve you. Look for them!

WALTER KIDDE & COMPANY, INC., 140 CEDAR ST., NEW YORK 6, N. Y.





Fluid Power DRIVES THE MERCURY DOWN

When the mercury in the thermometer rises too high, many things spoil—including tempers. But Fluid Power forces the temperature down, makes synthetic cold one of man's most useful servants.

Your electrical refrigerator is a good example of this type of Fluid Power. In a closed system of tubing, liquids change into gases and back again to liquids in a repeated cycle. Heat is extracted, carried away, then dissipated into the air.

Applications of this type of Fluid Power are expanding rapidly. Industry uses below-zero cabinets to obtain shrink fits. Home freezers may revolutionize the food storage problem of the future. Air cooling and conditioning may eventually become a standard in every home.

If you are considering product development using this type of Fluid Power, ask a Parker engineer. He is familiar with the new advances and applications in this field.

Ask a Parker Engineer about *Fluid Power*

Today, you'll find Parker-engineered Fluid Power Systems in locomotives and bombers, in ships, machine tools and chemical plants. If you need FLUID POWER for control or drive, talk the matter over with a Parker engineer. He has the kind of "know-how" you'll find most valuable. Write direct to The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

THE
PARKER
APPLIANCE COMPANY
CLEVELAND • LOS ANGELES
FLUID POWER ENGINEERING

A Movie Camera Fan is MADE...not born!



Jim's first movie of Judy was taken on their graduation day with one of the first Universals. Until the Universal movie camera and projector appeared, home movie equipment was too expensive for Jim.



Their honeymoon lasts forever on films Jim took of their Great Lakes trip. Thanks to Universal, thousands more people like them became home movie fans. In one year, the number more than doubled!



A new star is born, and Jim has movies of him from the age of two weeks up! Jim has graduated to the Universal Cinemaster—one of the finest 8-millimeter home-movie cameras on the pre-war market!



Jim's in the Navy now. He's still using a Universal—but now it's Universal Navy binoculars. For Universal, too, has gone to war . . . producing only precision optical instruments for the armed forces.



But tomorrow . . . home! Jim dreams of such a shot as this—perhaps shooting it through the window of his train as it pulls into the station, with Judy and his son waiting to welcome him home for good!



Even greater cameras and equipment will result from Universal's war-time pioneering of new methods of mass-producing military optical instruments. Expect YOUR next camera to be a Universal!

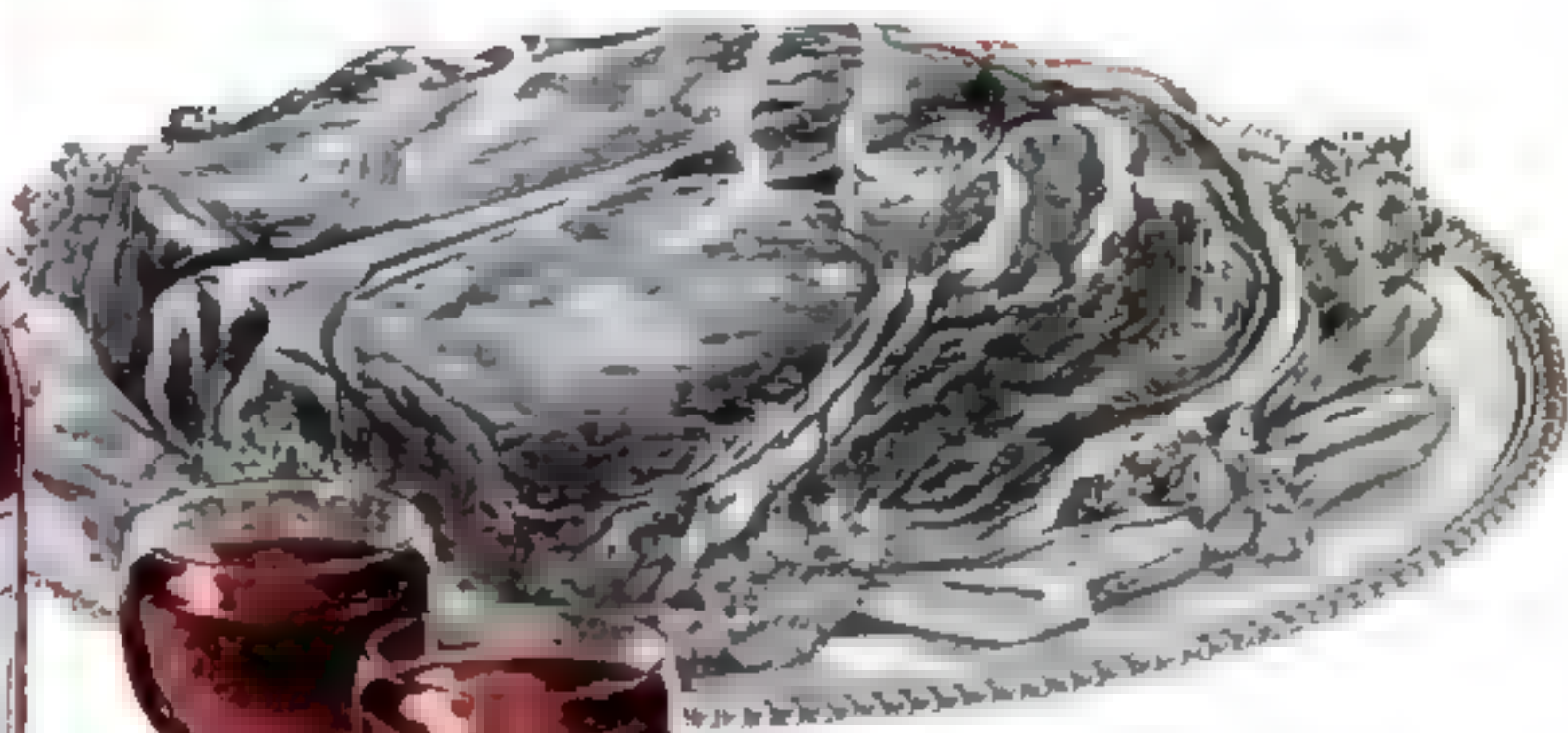
Remember: One photograph from home is worth a thousand words to a Serviceman



Peacetime Manufacturers of Mercury, Cinemaster, Corsair Cameras and Photographic Equipment

They're twice as good...together!

ROMA Wines



Easy, thrifty way to make meals taste twice as good!

WHEN dining alone, or when entertaining—here's a "plan" for the man who likes to make things: Tonight, make dinner taste *twice as good*—whether it be steak or stew, fish or fowl. Just serve a cool bottle of ROMA California Burgundy, Claret, or Sauterne with the meal! ROMA'S superb flavor, constant quality, and reasonable cost have made ROMA America's largest selling wines! Enjoy ROMA Wines daily with meals and when entertaining—for only pennies a glass! If your dealer is out, please try again.

**ABOVE ALL ELSE
BUY BONDS!**

ROMA California Wines include: Port, Sherry, Muscatel, Sauterne, Claret, Burgundy, Zinfandel, Champagne and Sparkling Burgundy.
ROMA WINE COMPANY
Fresno, Lodi, Healdsburg, California



ROMA *America's Largest-Selling Wines!*

There's
been a
big change



★ Football is still a matter of touchdowns—but time has developed a more skillful game with many technical improvements.

The duties of a tapered roller bearing are the same, too. Tyson, however, has introduced the *All-Rolls* design which has vastly increased its efficiency.

With the addition of *thirty percent more rolls*, Tyson has almost doubled ordinary roller bearing life. Size for size, the Tyson "All-Rolls" bearing has greater load capacity—more strength and rigidity. It's a heavy-duty bearing for heavy-duty jobs. *The big name in bearings today is...TYSON!*



TYSON BEARING CORPORATION • MASSILLON, OHIO

COUNT THE ROLLS THE GO & COUNT



Tyson
TODAY'S HEAVY-DUTY BEARING

★ BUY MORE WAR BONDS ★



Buy War Savings Bonds and Stamps regularly.

POPULAR SCIENCE



Can we fly AND KEEP OUR FEET ON THE GROUND?

SURE, there's something inspiring about flying—a something that lifts thoughts aloft beyond earth-bound tradition.

As pioneers in the design and production of light planes, Taylorcraft has seen the ease of taking off into realms of wishful thinking and sometimes pure fantasy.

But we at Taylorcraft, all of us—designers, engineers, production men, and management—believe we must keep our feet on the ground while planning future flying for a peacetime America. We believe overstatement and the promise of dream miracles will only harm and impede the future of the light plane industry.

We suggest that all of us—pilots, instructors, fixed base

operators, manufacturers, and others interested in flying—be cautious in our claims for future planes now in the design stage. So don't over-sell flying—it doesn't need it.

This does not mean that Taylorcraft is standing still, but rather that new Taylorcraft innovations and improvements will be tempered by practical considerations.

Our obligation, as we see it, is to perfect as closely as possible, the safe, sure, low-cost plane that will measure up to tomorrow's requirements, without fuss and fanfare or circus hullabaloo.

Taylorcraft is also re-establishing and enlarging its national representation and service facilities. Write us for more details.



Taylorcraft

World's Largest Builders of Side-By-Side Airplanes

TAYLORCRAFT AVIATION CORPORATION • ALLIANCE, OHIO

OCTOBER, 1941

Buy War Savings Bonds and Stamps regularly.

253

1st Prize

in contest which
you have a chance
to win!

\$1,000.00

(Retail value)

in Delta equipment for a Homecraft Shop

199 Other Prizes Given Away FREE in Delta Post-War Shop Planning Contest!

Useful Prizes that bring happiness to you

★ 1st Prize ★

Your choice of
\$1,000.00 in Delta Equipment
(retail value)

★ 2nd Prize ★

Your choice of
\$500.00 in Delta Equipment
(retail value)

★ 3rd Prize ★

Your choice of
\$250.00 in Delta Equipment
(retail value)

★ 4th to 8th Prizes ★

Your choice of
\$75.00 in Delta Equipment
(retail value)

★ 9th to 20th Prizes ★

\$10.00 worth of Delta
Accessories and/or Supplies!
(retail value)

(Merchandise certificates will be awarded to winners entitling them to prizes when materials required for making Delta equipment are released by the government.)

★ 21st to 40th Prizes ★

Set of 27 Delta-Craft Project Books and Manuals! \$4.50 value! A complete education in modern shop practice.

★ 41st to 60th Prizes ★

Set of 6 Delta Tool Manuals — Value \$1.50! Shows how to master tools and operations.

★ 61st to 200th Prizes ★

1 Year's Subscription to The Delta-gram! Value \$0.50. The popular, plan-packed homemaker's magazine.

Nothing to buy! No entry fee! You don't have to be an expert to win!

Think of it—you have a chance to get \$1,000.00 worth of famous Delta equipment (post-war delivery), or one of 199 other valuable Delta prizes, *absolutely free!*

What a swell opportunity to have a complete Delta-equipped homecraft shop you can really be proud of—and where you and all the family can enjoy fun and healthful recreation!

Here's What to Do

All you have to do to become eligible for these big prizes is simply

tell us in your own words your idea of a practical homecraft shop. Maybe it's that shop you've been dreaming about — or perhaps it's an improvement on the one you now have.

Whatever it is, simply send us a sketch of the floor plan (we don't expect a finished drawing) — together with a statement covering the points listed in the rules below. Include any ideas you think can put you among the winners.

You've Got to Start Now!

This exciting contest closes Tuesday, October 31, 1944. Your entry must be postmarked not later than midnight of that day.

So don't delay. Start your plan right now. And be sure to mail it on time.

DELTA
MILWAUKEE
Power Tools

Be Sure to Read these Rules!

1 The contest is open to any person of any sex (male or female) residing in the United States or Canada, except employees of The Delta Co., except employees of Delta Manufacturing Co., dealers and distributors of Delta products and their employees, employees of Delta's advertising agency, and members of the immediate families of any of the above.

2 Entries are to consist of a floor plan or layout of the entrant's proposed post-war homecraft shop showing position of power tools, workbenches, and other major equipment, together with a statement giving the following information:

- Reasons for adopting layout and equipment shown in floor plan.
- List of power equipment now owned.
- List of power equipment planned for purchase after the war, the prices you would pay, and name of store where purchase would be made.
- List of hand tools and other accessories now owned.
- General type of work to be done in the shop.

3 Entries will be judged on their suitability to the type of work to be done, efficiency and ingenuity of arrangement, and use of space available. Neatness and clearness will count, but not costliness or elaborateness of the presentation.

4 All entries must be postmarked not later than midnight Tuesday, October 31, 1944. They are to be mailed to Contest Editor, The Delta Mfg. Co., 8421 E. Vienna Ave., Milwaukee 1, Wis. Entries become the property of The Delta Mfg. Co. to be used as they see fit, and none can be returned.

5 Decisions of the judges will be final. In case of ties, duplicate prizes will be awarded.

6 Contestants are limited to one entry. If more than one entry is submitted by a contestant, only the first one received will be considered.

7 Final judging will be done by:
William Bachrach, Regional Coordinator of Engineering, Science and Management, War Training.
E. R. Hean, Technical Editor, Popular Mechanics.
Harry Wallen, Home and Workshop Editor, Popular Science.



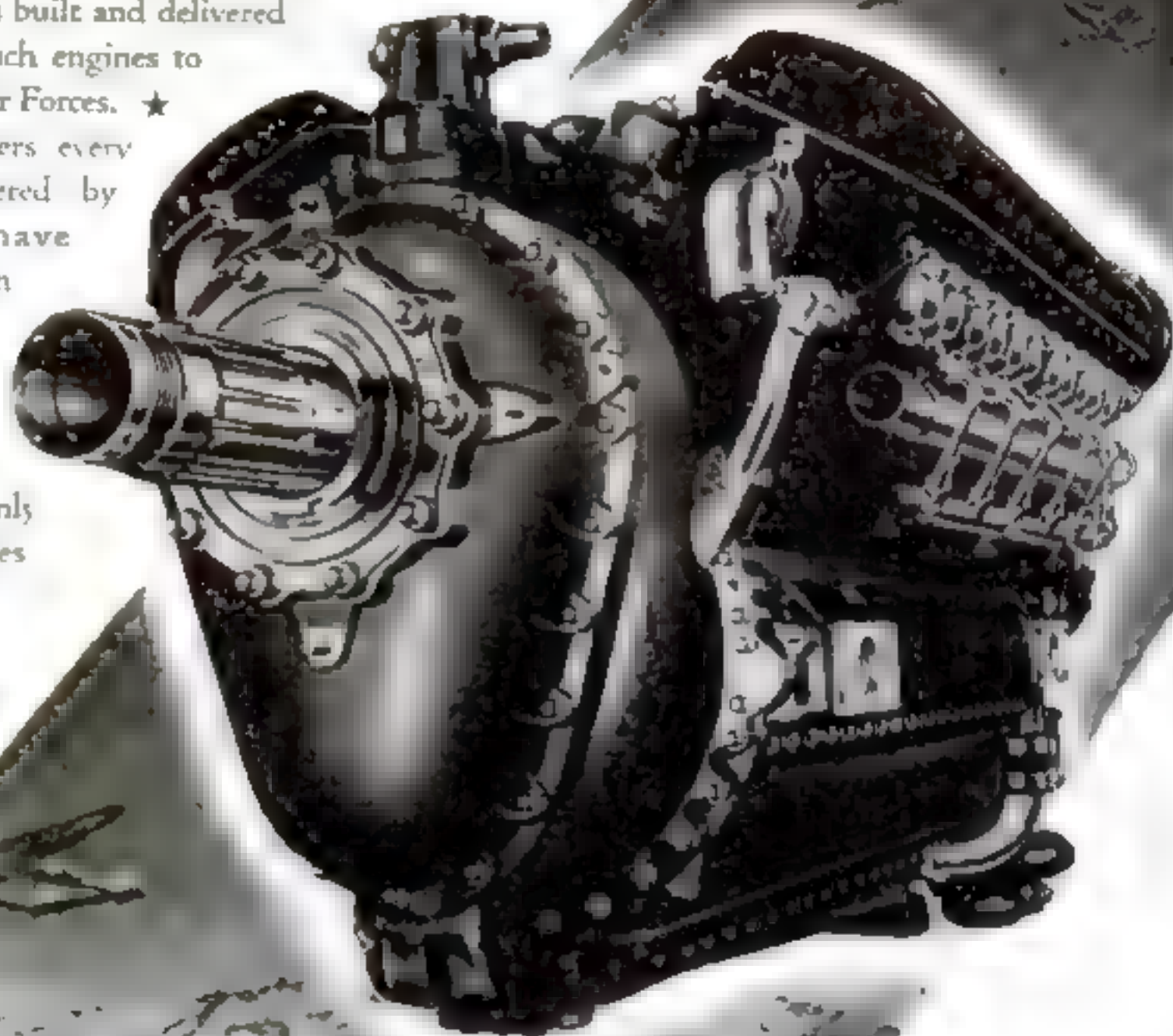
U. S. Navy's Grumman Hellcats—Escorts of the Sky

Grumman
AIRCRAFT ENGINEERING CORPORATION, Bethpage, L. I., N. Y.

THEY MUST BE GOOD

The battle record of American fighter pilots plainly says, "They must be good!" ★ Here at home, our firm resolve is that the engines we supply them must be good too — the best that care and precision and long experience can produce. Allison has built and delivered more than 50,000 such engines to the U. S. Army Air Forces. ★

In service that covers every front, planes powered by these engines have helped to run up an impressive score against enemy aircraft. ★ This is an indication of qualities useful not only in war but in engines to power the planes in which you will travel when peace has been won.



POWERED BY ALLISON

P-48—Lightning
P-50—Arrow
F-4U—Corsair
F-6F and F-76—Mustang
P-63—Kingscobra

More than 50,000 Allison engines built for the U. S. Army Air Forces power the above planes.

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF
Indianapolis, Indiana

Every Sunday Afternoon •

GENERAL MOTORS SYMPHONY OF THE AIR — NBC Network



**KEEP AMERICA STRONG
BUY MORE WAR BONDS**

**"WITH THE WIND BLOWING MY HAIR
AND SINGING A SONG IN MY EARS"**



"I was in Alaska over a year — am now somewhere in the Aleutians. The Harley-Davidsons here are doing praiseworthy work and giving faithful service. It's good your machines are made to stand hard punishment. I long to be back in the saddle of my own faithful Harley-Davidson again — *with the wind blowing my hair and singing a song in my ears.*"

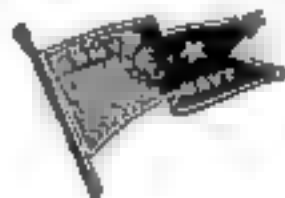
The story is always the same. Thousands of letters tell of Harley-Davidsons' superior performance under severest war action. And thousands of riders tell how eager they are "to get this thing over with so we can have a new HARLEY-DAVIDSON for the thrilling motorcycling days to come." **BUY WAR BONDS NOW**, to make those days come soon!

**HARLEY-DAVIDSON
MOTORCYCLES**

HARLEY-DAVIDSON MOTOR CO.
Dept. PS, Milwaukee 1, Wisconsin

Please send at once free copy of 24-page
"Enthusiast" Magazine, filled with motor-
cycle action pictures and thrilling stories.

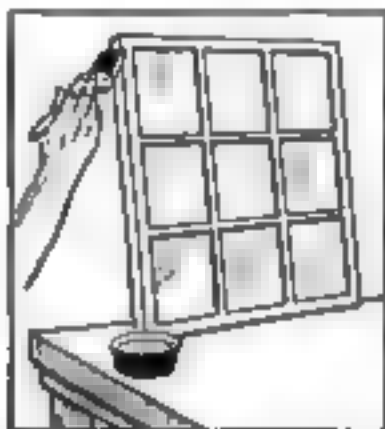
Name
Address
City State



WORKSHOP WISDOM

How to make windows slide easily

To end the annoyance of sticking windows and drawers, follow these easy directions:—



1. Clean off any excess paint . . . sandpaper smooth all sliding surfaces.

2. Apply a thin coat of Cascamite to these surfaces. Let dry and sandpaper again lightly.

3. Rub frames with paraffin or wax candle.

Cascamite will sink into the wood pores, harden, and help prevent future swelling or sticking.

Cascamite for scores of wood-gluing jobs because:

It's Waterproof. Ideal for jobs exposed to weather, water, or excessive dampness.

It's Stronger. By actual tests, joints made with Cascamite are as strong as the wood itself.

It's Economical. Comes as a dry powder which keeps well, doesn't "dry up." Mix (in cold water) only the amount you need for the job.

You can get Cascamite Plastic Adhesive—as well as Casco, the all-purpose household glue—in 10¢, 25¢, and larger sizes at all hardware stores.

Send for free Casco Project Booklets and free Gluing Guide containing 80 household gluing hints. Drop a post card to Casco Company of America, Dept. 8-1, 350 Madison Avenue, New York 17, N. Y.

CASCAMITE

Plastic Adhesive



NEW IDEA FOR TOUCHING UP AND REFINISHING FURNITURE!



• Surface stains or small nicks and scratches on furniture aren't quite so serious as they may appear to be. Shinola Waxes do a swell cover up job. Whether the piece of furniture is old or new—cherry, maple, or pine—there's a Shinola Wax to match wood of any age or color. These colored waxes are particularly helpful in restoring a rich, mellow finish to older pieces.

These same Shinola shoe-polishing waxes are swell for preserving linoleum . . . for finishing airplane and ship models, too. Ask for them by name . . . SHINOLA.

War-time places heavy demands upon our supplies, so if your dealer is temporarily out of stock, please be patient.

SHINOLA-10¢

IN ALL COLORS

NEUTRAL • TAN • BROWN • OX-BLOOD • BLACK



"HOW TO WORK WITH TOOLS AND WOOD" A popular book on working, packed with illustrated instructions for beginners and with useful data for experienced woodworkers. Every home workshop should have a copy. A Big Value at \$1.00

STANLEY TOOLS Division of The Stanley Works, PS-2104 On St., New Britain, Conn.

IT STAYS ON—RUST STAYS OFF

FIENDOIL

RUST INHIBITOR

Keep home tools, appliances, corrosive metal protectively coated.

35c Battle News.—Sptg. Goods Dealers
McCambridge & McCambridge Co., Baltimore 23, Md



RATIONED MOTORISTS



Now Get EXTRA GASOLINE MILEAGE

Now you can get up to 30% extra gasoline mileage with a Vacu-matic on your car. Quicker pick-up, smoother running, added power and precious gasoline savings guaranteed.

Automatic Supercharge Principle
Vacu-matic is entirely different! Operates on the Supercharge principle. Saves gas. Automatically provides a better gas mixture. Guaranteed to give up to 30% extra gas mileage, more power and better performance.

FITS ALL CARS

Constructed of six parts, forced into a single unit. Adjusted and sealed at the factory. Very quickly installed by anyone.

AGENTS TRIAL OFFER

Every car truck tractor a prospect. Send name address on postcard for big money making offer and how you get yours for introducing.

Vacu-matic Co., 7817-987 W. State St., Milwaukee 13, Wis.

VanRoy



*Signet of Quality
in Pipes*



No casual smoker is a VanRoy owner. Each pipeful brings moments of rare enjoyment — from the luxurious first puff to the last reluctant draw. Moments like these are priceless, yet easily within reach. Discover for yourself the uncommon satisfaction of possessing a VanRoy Pipe.



VAN ROY COMPANY INC., EMPIRE STATE BUILDING
NEW YORK 1, N. Y.

VanRoy Pipe Family

VanRoy ARISTA	3.50
VanRoy HARD	5.00
VanRoy COURIER	7.50
VanRoy DI MONT	10.00



Patriot, President —and penman!

General Washington, in dark days, led his country toward light. This peerless patriot was also a potent penman—wrote fiats and commands, ledgers, memorable memoranda, with quills of geese.

Today, the pen behind the sword is Inkograph—chosen by many generals, and hundreds of thousands of men in service. Easy flowing, precision-built, pointed to fit pressure of any hand, light yet durable, it is as dependable in the field as in the office and home.

If your dealer is out of stock, please keep trying!

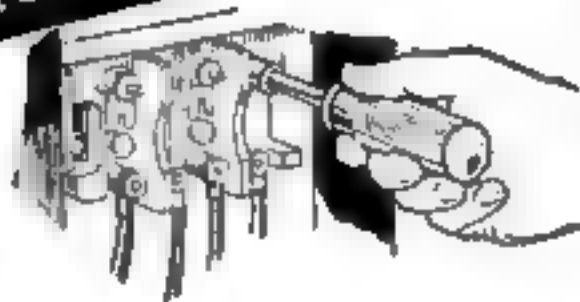
Sorry, no mail orders; only dealers can supply you.

*Use any pen to sign up for more
WAR BONDS!*

INK-O-GRAPH²
Inkograph Co., Inc., 200 Hudson St., N. Y. C. 13

Buy War Savings Bonds and Stamps regularly.

**ON SWITCHBOARDS...
PANEL EQUIPMENT**



MAKE EASY WORK of Nuts in Tight Places with XCELITE Hollow Shaft Nut Drivers

A real expeditor of jobs on radio panels, telephone and power switchboards. The hollow shaft slips over protruding studs; accurately machined socket accommodates two nuts. Genuine shock-proof Xcelite handle. Shafts insulated if desired. Seven sizes, from 5/16" to 3/4" (nut sizes). Priorities required—sales restricted. Ask your hardware, radio or mill supply dealer or write Dept. I.

PARK METALWARE CO., INC.
Graham Park New York

XCELITE

BACK THE ATTACK—KEEP THE WAR BONDS YOU BUY



USE YOUR BENCH SCREW

With Our six in. tool steel cutters. Make moldings, casings, drop-leaf tables, grooves, beading & jointing 1" wide \$1.50. 1 1/4" \$2.75. ea. Postpaid. State size hole. List & folder free. John A. Sundstrom, Box 517, Stow, N. Y.

There's no finer way than the American way. Let's keep it that way. Buy War Savings Bonds and Stamps regularly.



CRAFTSMEN *Get this* BOOK OF MATERIAL, SUPPLIES & TOOLS... STILL AVAILABLE

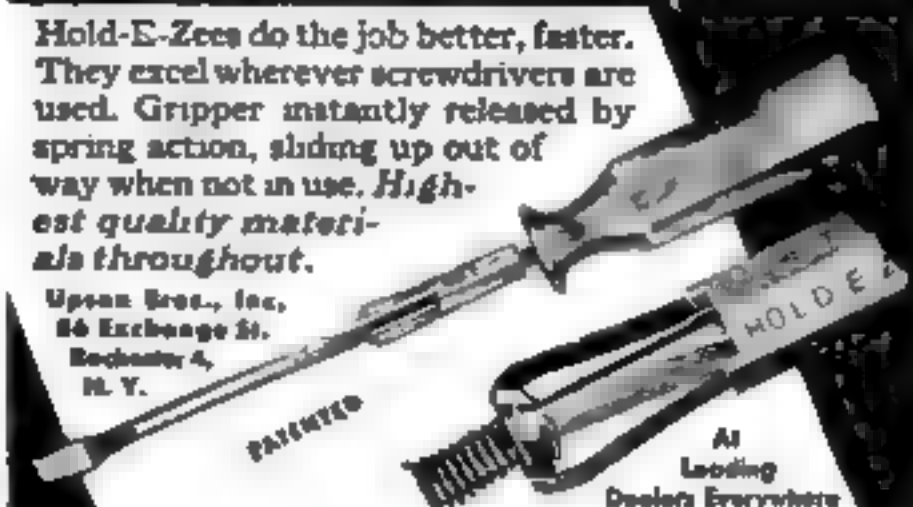
Full of valuable hints and short cuts plus listing of a huge practically complete list of materials, tools and supplies. Features Identification Panel and Chart of over 80 Rare Woods in Natural Color plus full color showing of over 100 color borders in natural color. Send only 25c, stamp or coin, which is refunded on first order of \$1.00 or more, making this valuable manual cost you nothing.

ALBERT CONSTANTINE & SON, INC.
751 W. East 175th St. New York 34 New York

HOLD-E-ZEE AUTOMATIC GRIP SCREWDRIVERS

Hold-E-Zees do the job better, faster. They excel wherever screwdrivers are used. Gripper instantly released by spring action, sliding up out of way when not in use. Highest quality materials throughout.

Upton Bros., Inc.
86 Exchange St.
Rochester 4,
N. Y.



At
Leading
Dealers Everywhere

For Jungle Fighters Today— For YOU Tomorrow



This Amazing NEW "Pocket" Stove Originally Designed by Coleman

is now serving jungle fighters, ski-troopers, tank crews, rangers—gallant fighters everywhere.

It's the sport stove of tomorrow you'll never want to be without on any after-victory outdoor trip. Easy to carry as a thermos bottle—only 8½ in. high, 4½ in. in diameter. Ready in minutes for cooking, heating drinks, purifying water. **BURNS SAME FUEL USED IN YOUR CAR**—white or leaded—fuel that is available everywhere. Telescoping case makes handy utensils.

Originally designed by Coleman engineers for the armed forces, this new miracle stove will be ideal for vacation travel, picnics, backyard steak fries, hunting, fishing and camping—hundreds of uses about the home—after the war.

FREE BOOK—Write for dramatic picture story of the Coleman "Pocket" Stove on the fighting fronts.

THE COLEMAN LAMP AND STOVE CO.
Wichita, Kans. Chicago, Ill. Philadelphia, Pa.
Los Angeles, Calif. Toronto, Canada



for Outstanding
Achievement
in War Production

Coleman

"POCKET" STOVES • CAMP STOVES • LAMPS • LANTERNS • IRONS

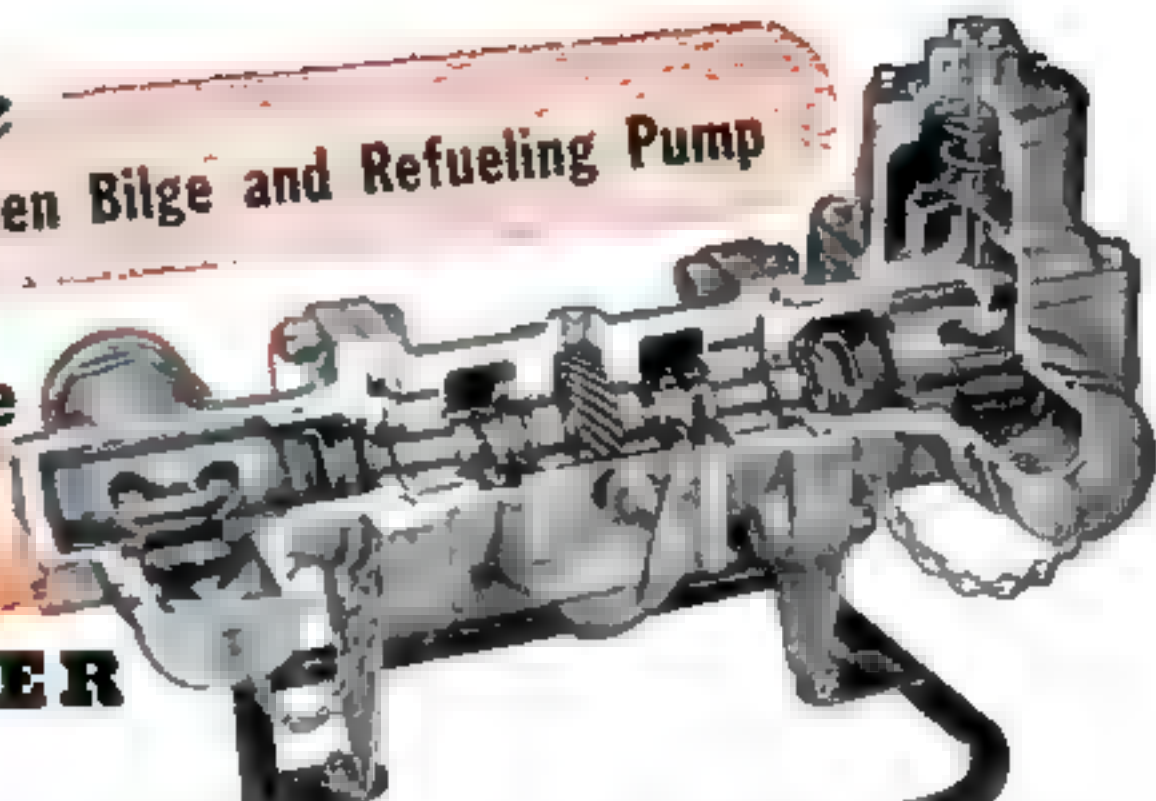
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★ "Teamwork does it," says Capt. Robert Ebey, pilot, of Stillwater, Okla. "In the air we fight as a team. Co-pilot is 1st Lt. Paul Sjöberg, of Grand Marais, Minn.



★ 1st Lt. Hilliard Peavy, navigator, of Montgomery, Ala., checks course. In the waist, Sgt. Francis Donnelly, radio-gunner of Philadelphia, mans the radio equipment.



★ Sgt. Donnelly shares his "office" with S/Sgt. Lyle Wilson, mechanic-gunner, of Conneaut Lake Park, Pa. Sgt. Wilson takes care of engines, and all mechanical systems.



★ 1st Lt. George Jernigan, bombardier, of Charleston, W. Va., has plastered Jap airfields, railroad yards, and bridges all over the China-Burma-India theater.



★ S/Sgt. Rudolf Madsen, of Eugene, Ore., tail-gunner. Flying, fighting, working together, the air combat crew of the "Old 59" is a typical AAF team.

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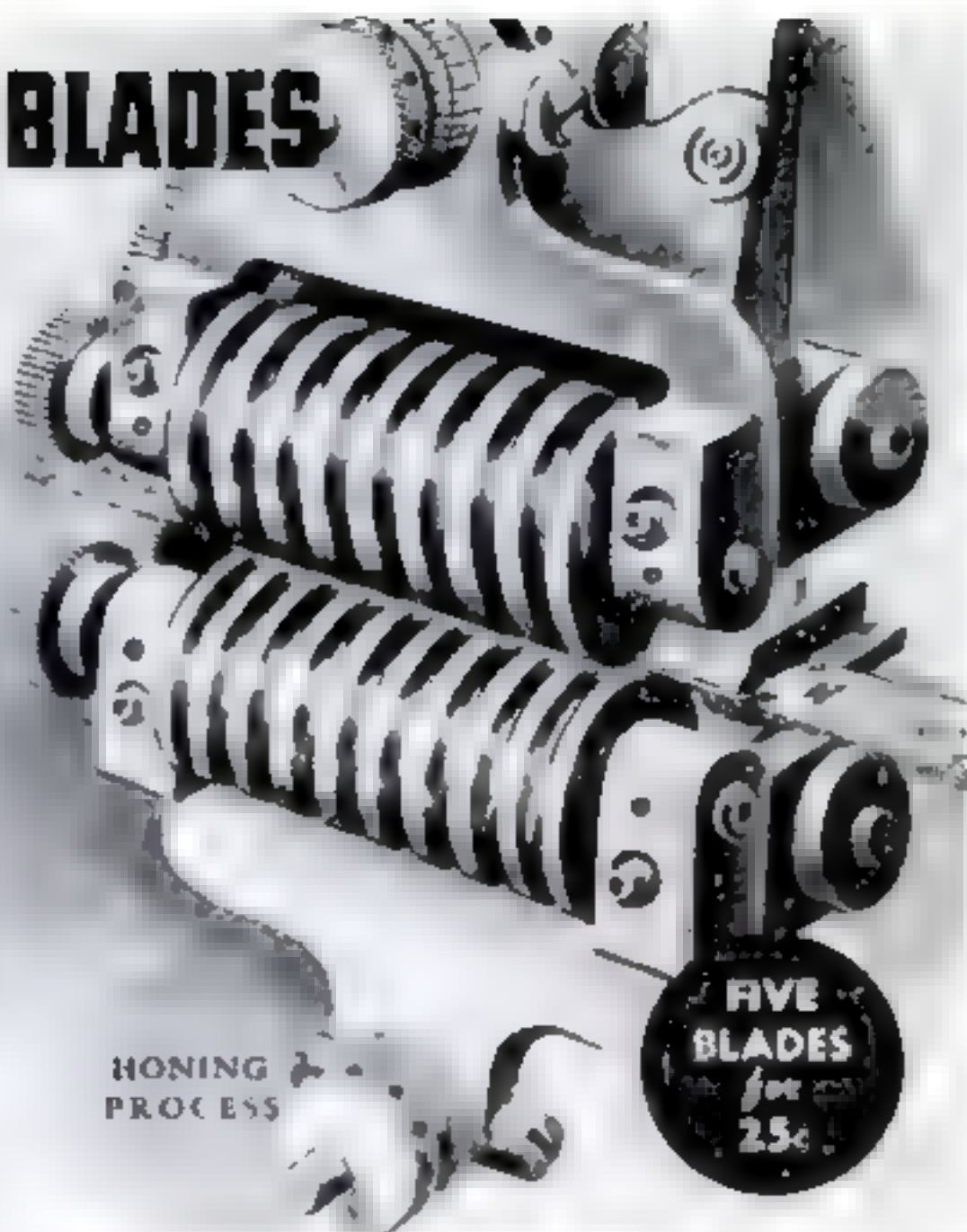
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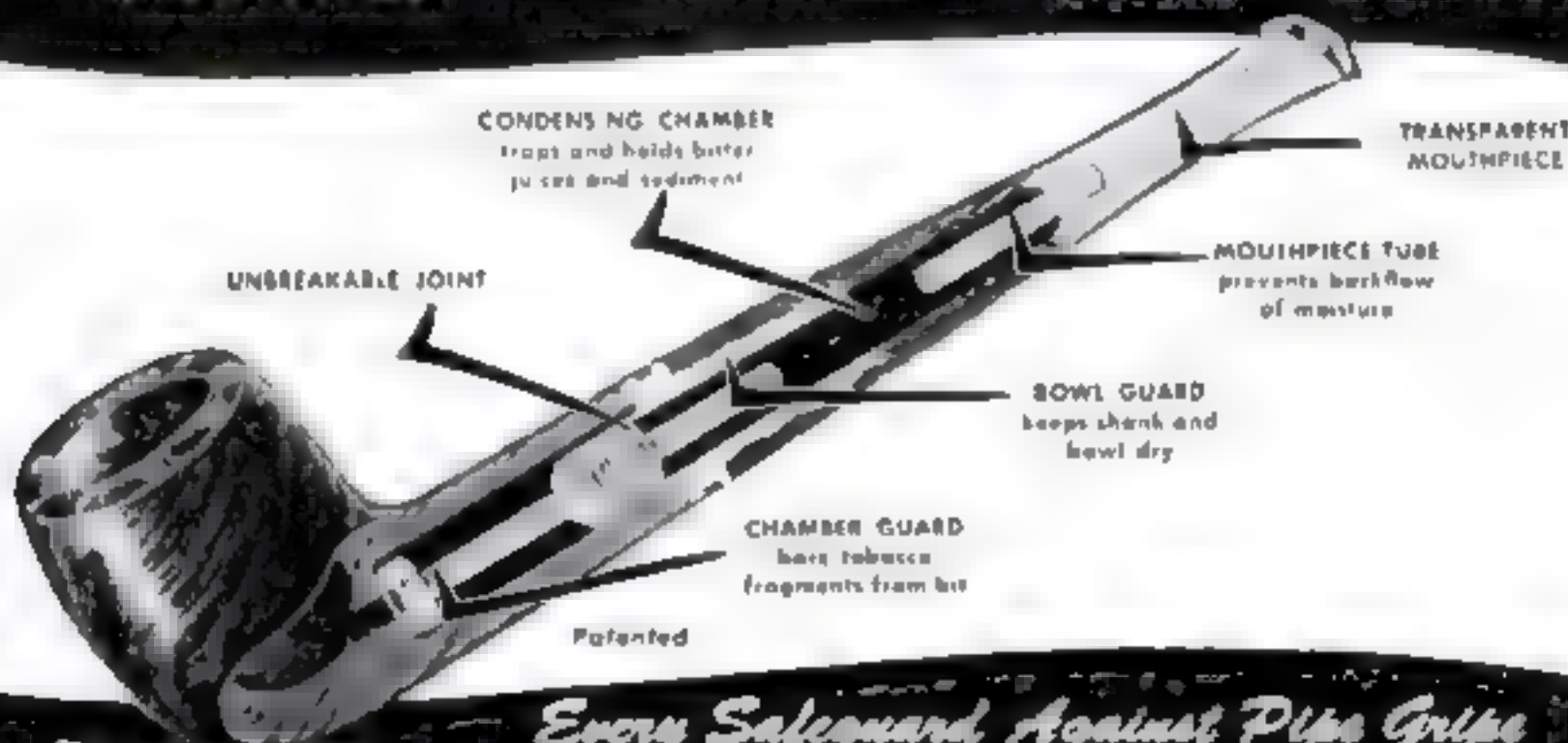
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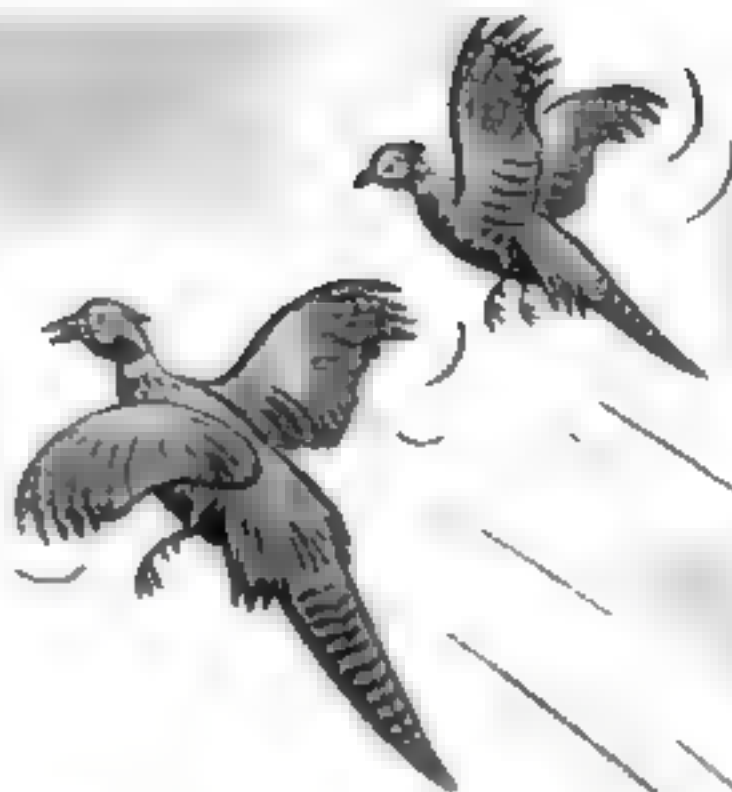
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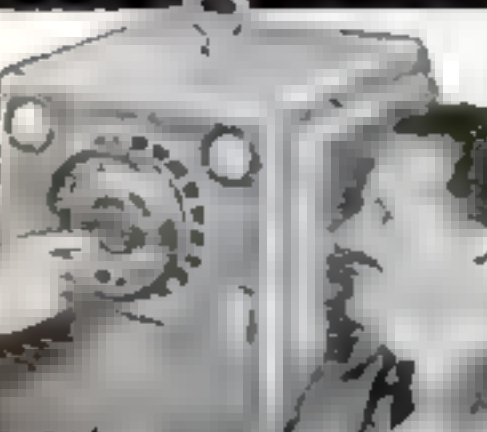


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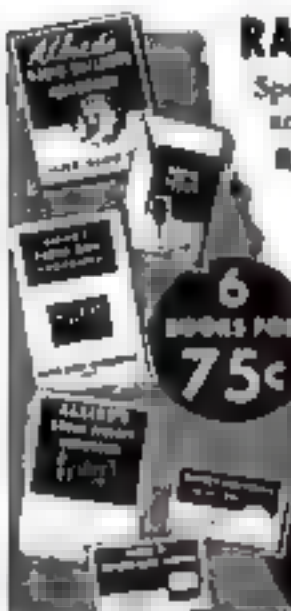
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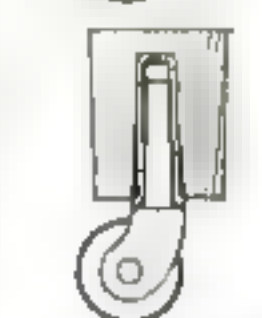
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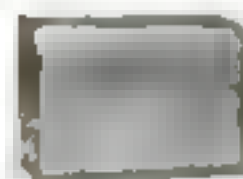
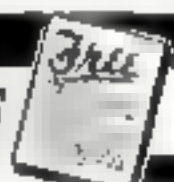
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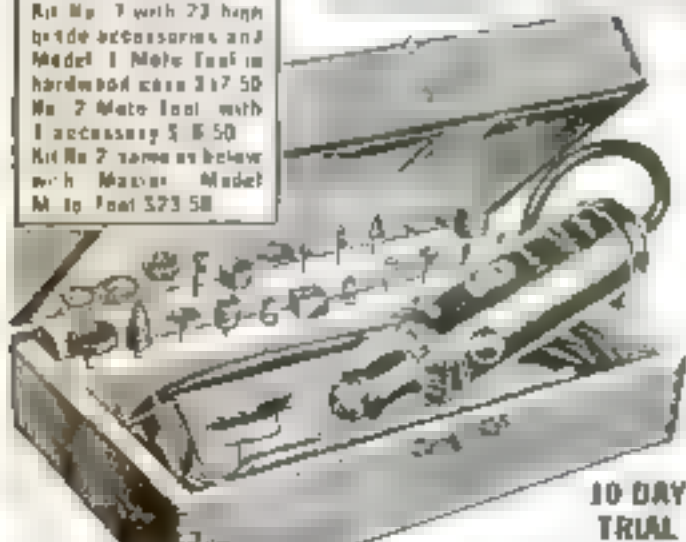
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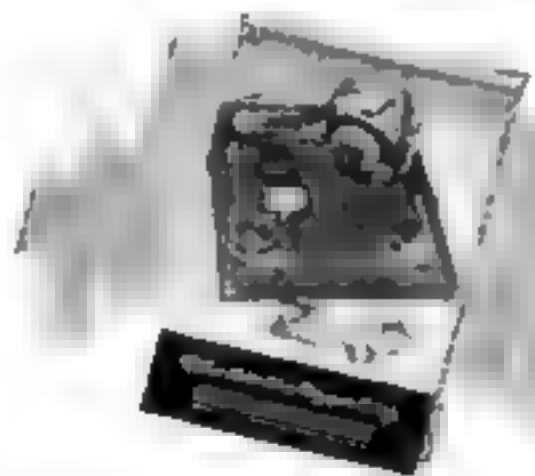


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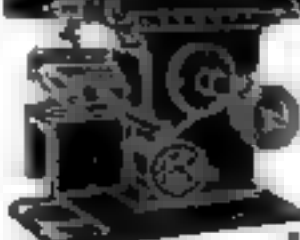
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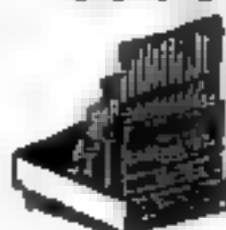
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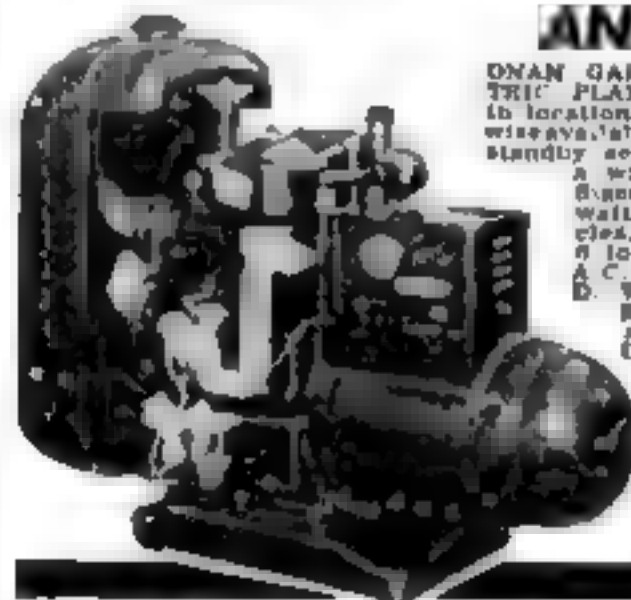
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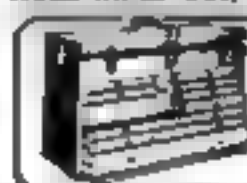


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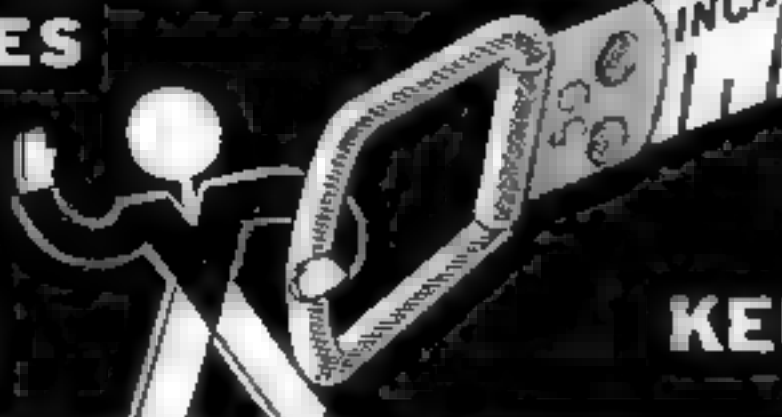
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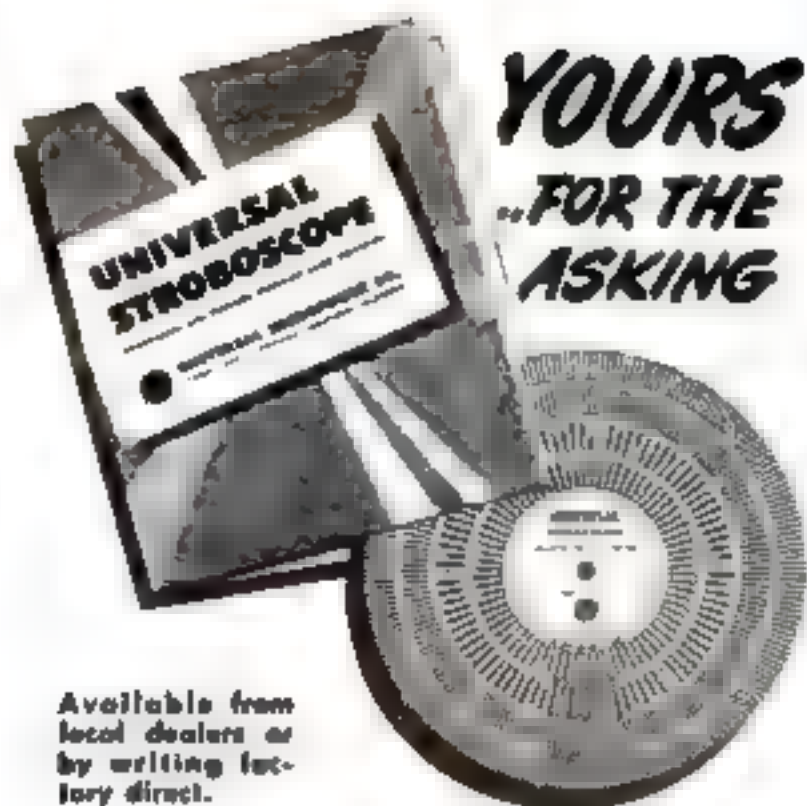
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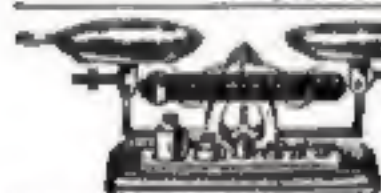
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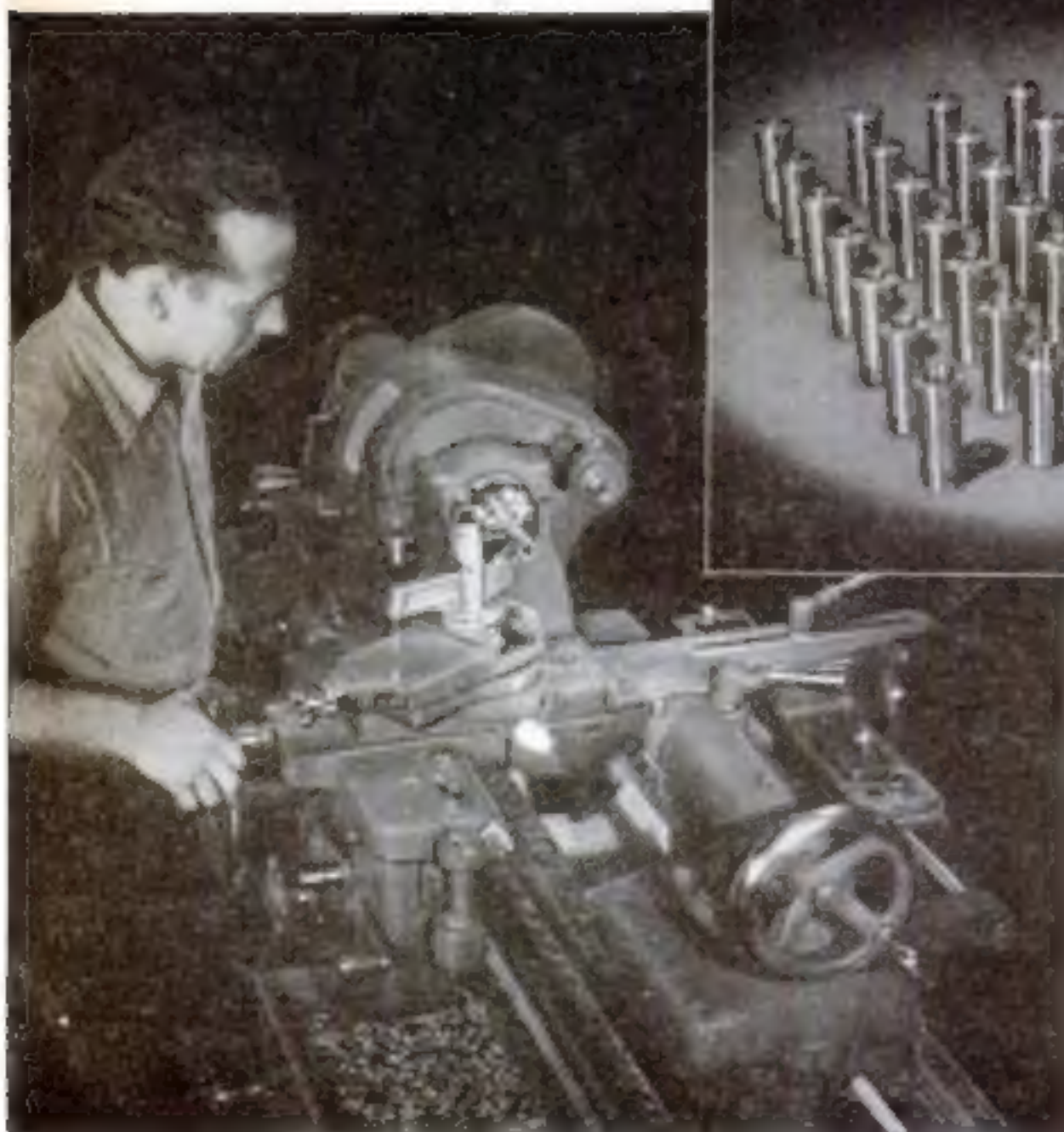
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